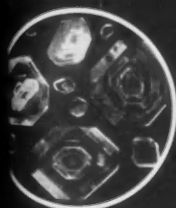
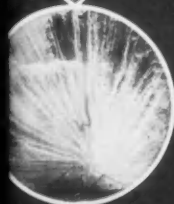


# CHEMISTRY



SEPTEMBER  
1956



Thirtieth  
Year

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## Editorial:

The Mauve Chemical Century  
Inside Front Cover

Cover Color Celebrates Mauve Centenary

50¢

★ A SCIENCE SERVICE PUBLICATION ★

# The Mauve Chemical Century

► A CENTURY AGO a 17-year old boy made the first synthetic dye, mauve. True, it was an accident, Perkin was trying to make quinine, which despite the astounding advances of synthetic chemistry has not yet been achieved on a practical scale. (There are now synthetics better than quinine that not only cure but prevent malaria.)

From such beginnings the science and industry of synthetic organic chemistry had magnificent development which could be called the mauve chemical century if the word mauve had not been linked to a particular decade.

Not dyes alone, although they are of great use and importance, but the mauve century has produced drugs, pharmaceuticals, textiles, plastics, explosives, and scores of materials, both replacing natural materials, like the synthetic dyes, and providing substances never before known.

The mauve century has seen the rise of creative chemistry and the shifting of the chemical ascendancy from nation to nation. Britain, thanks largely to the pioneering of Perkin and his associates, led the world in synthetic chemistry. Then the Germans, learning from the British, developed their powerful chemical industry that dominated the world trade and finally contributed to the Kaiser's attempt at world conquest. After the first defeat of Germany, the United States became self-sufficient in organic chemistry and did its share in new discoveries and developments.

The atomic age, which is basically chemical in the real sense of the word, has not supplanted the organic, synthetic era based upon the mauve century. There has been an acceleration of the science and art of synthetics, as well as an expansion of their scope.

The world has more appreciation of chemistry than ever before, a science needed for industry and defense alike. Every nation is concerned with the training of youth in chemistry as well as other sciences. To youth in school today, many of whom are about Perkin's age at the time of his great discovery, chemistry presents an immense challenge and opportunity.

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► CRUSHED zirconium sponge is pressed at 50 tons per square inch to produce two-inch square bars, which are welded together to form electrodes. In an electric furnace, with air replaced by helium or argon, zirconium electrodes melt when the electric current arcs across them. By such violent methods pure zirconium for building atomic reactors is won from its jewel-like zircon ores.

Chemistry Library

## Firebrand Metals

by HELEN M. DAVIS

► DESTRUCTIVE fires are reported with increasing frequency as originating in metallurgical laboratories. We are accustomed to thinking of metal-clad surfaces as fireproof. But these fires are often associated with the newer metals, such as zirconium, hafnium,

or titanium. This must often raise the question as to what kind of metals these may be, to be so dangerous.

Although traces of today's unfamiliar new metals were identified long ago in rocks, by the kinds of compounds they made in chemists' test tubes, and small amounts of the ele-

ments were extracted in metallic form for curiosity's sake, their production in quantity is really new. The hazards run by the men who handle these metals as scrap are just being learned, often by the route of costly accidents.

Most metals will burn. The temperatures at which they kindle are high and, because they conduct heat readily, it is difficult to start combustion of such familiar metals as iron, copper or aluminum when they are in massive form. Most people do not have the experience of seeing metals burn, although finely powdered iron contributes the beautiful "shooting stars" to Fourth of July sparkler fireworks. Single strands of fine "steel wool" may be burned in the flame of a kitchen gas range (CAUTION! don't get burned yourself, when you try it!).

Some metals catch fire at rather low temperatures, and burn readily. Manganese has long found one of its chief uses in flares and flashlight powders. The danger of fire from magnesium has been known from the beginning of its large scale production, so precautions have, perhaps, anticipated many possible sources of trouble. Magnesium produced from sea water has recently become a commercial alloying metal, for lightweight structures.

Another fiery metal recently brought out of the laboratory is sodium. Its specialty is combining with water. In doing so it sets free hydrogen gas, which catches fire because of the heat of the chemical reaction. Safe handling of sodium is a recent triumph of chemical engineers, who have devised ways to keep air and moisture away. Sodium now promises to find particular use as a coolant in

future types of heat engines, because it is easily liquified. It has already found such use experimentally in atomic energy installations. Sodium has been tamed.

Some of the newer metals have other dangers besides magnesium's hunger for oxygen and sodium's thirst for water. Titanium, zirconium and hafnium combine with nitrogen as well.

Nitrogen makes up nearly three-fourths of the air. We are accustomed to congratulate ourselves that it dilutes the reactive oxygen, so that combustion is slowed down. But when metals burn in both oxygen and nitrogen, no diluting agent is left in the atmosphere except the one percent of the inert gases, mostly argon. The more familiar helium is a member of this group.

Metallurgists take advantage of these inert gases, and use them as a "blanket" to keep air away from burnable metals. The inert gases are collected from liquefied air, whose oxygen and nitrogen are separated out and used for other purposes.

The process by which the newer metals are won from their ores marks one of the great advances in metallurgy. It was perfected by Dr. W. J. Kroll, shortly before 1940, at first on a laboratory scale, for production of titanium, then of zirconium. As recognition of zirconium's unique usefulness in atomic energy plants forced expansion to a basis of pounds instead of ounces, Dr. Kroll, then at the Oregon station of the U.S. Bureau of Mines, supervised the expansion of production methods.

Judged by the standards of large-scale metallurgy, the Kroll process is fantastically complex and expensive.



But the properties of the newer metals are such that they must be had at any cost. Production engineers tackled the many problems that went with expansion of the process from an experiment carried out in laboratory glassware under the eye of a chemical specialist to a practical large-scale operation controlled by thermostats and running in closed metal vats.

At every step, precautions must be taken to keep air away from the hot metal. Clever designers have worked out a furnace where an atmosphere of helium is maintained which helps to regulate the reaction. In the furnace, chlorine gas takes zirconium away from the oxygen with which it was combined in the sandy mineral. The resulting compound then reacts with molten magnesium. The end result is a mass of magnesium chloride which is hard to remove from the reaction pot, and a spongy mass of zirconium metal requiring an even more elaborate procedure to get into workable form.

It is one of the mysteries of chemistry that after this remarkable family of metals has been protected so carefully from accidental combustion during the refining process, titanium, zirconium and hafnium when finally obtained in fabricated form do not corrode. Neither acids, air nor sea water attack them. Engineers look forward to many uses for the new metals when they can be bought more cheaply. Chemists are studying their unusual compounds for clues to their simplified production.

After the initial success of the Kroll process in producing titanium, it was adapted to production of zirconium and separation of this element from

its almost inseparable companion, hafnium. The method is still a batch process. The modifications which might make continuous production possible are still to be devised.

Zirconium is one of the metals whose ores are often classed as gem stones. Zircons are clear, crystalline stones, used as substitutes for diamonds. Other forms of the mineral are not brilliant crystals, but are found in beach sands and river-washed rock fragments, where they are recognized by their weight. Zirconium has about three times the atomic weight of silicon, chief constituent of ordinary sand. Zircon, the commonest ore, is classified as zirconium silicate. A rarer mineral is Baddeleyite, which is zirconium oxide. Titanium occurs similarly in mineral-bearing sands. Its synthetically made oxide can be cut, like zircon, to a beautiful diamond-like gem, indicating the relationship of these sister-elements.

Most useful metals occur in the earth's crust in combination with oxygen or sulfur, and most smelting operations involve taking the oxygen or sulfur away. Roasting with carbon, in the form of charcoal or coke, is sufficient to accomplish this in the most primitive kinds of metallurgy. Addition of "fluxes" to make the rocks melt at a lower temperature was an early improvement in the history of mankind. There was not much change in metal-producing techniques until the discovery of electrolytic methods, only a little over a century ago. The newer metals require refining processes of much greater chemical sophistication.

It is important to achieve as high a degree of purity as possible in

refining zirconium, because the pure metal is ductile and relatively easy to work, while presence of its compounds with oxygen and nitrogen, which are very hard to exclude, make the metal brittle. The refining method which has been worked out by Dr. Kroll and the U. S. Bureau of Mines proceeds in several steps.

In the first step, zircon mineral and carbon are heated in an electric arc furnace, with production of zircon carbide or carbonitride. Air must be kept away from this compound as it cools, or it may go up in a spontaneous display of wasteful fireworks.

Next the carbon in the zirconium compound is exchanged for chlorine. Four atoms of chlorine will combine with each zirconium atom, in a chemical reaction which gives off heat. The resulting crystalline compound is then put through a number of purification processes, some of which the Government has not revealed.

During the purification processes, zirconium is separated from other elements which occur with it. Titanium, its sister element, is easily removed at this stage, for its tetrachloride is a liquid. Hafnium, the other member of zirconium's immediate family, is practically a twin to the element sought. Chemical resemblance between the two metals is so close that there is difficulty in separating their compounds. Yet, for use around nuclear reactors, zirconium's most important career, the inevitably accompanying hafnium must be removed. Hafnium gobbles up neutrons, while zirconium is one of the few substances in nature indifferent to them.

After sponge metal, especially zir-

conium or hafnium, has been broken out of the reaction pot where it has been made by the Kroll process, there is still the problem of getting the metal into workable form. The first part of the refining routine used chlorine to separate contaminants from the metal. Another halogen element, this time iodine, performs the next purification reaction.

In the original laboratory form of the apparatus, as applied to zirconium refining, sponge metal and iodine were put into a glass bulb not much different from an electric light bulb. A heated wire filament in the center collected the purified metal. The gaseous iodine attacked the sponge metal, forming zirconium iodide. This would break up as it neared the hot filament, leaving a thicker coating of zirconium on the filament. The iodine atoms were then free to attack the remaining sponge and ferry more zirconium across. Atom by atom the metal, now pure enough to be ductile, was built up. Half a pound was a large run for these early "furnaces."

During the Second World War, the Westinghouse Electric Corporation furnished zirconium to the Atomic Energy Commission from installations which were essentially the same as this little glass bulb, but magnified until they produced bars an inch in diameter, 60 inches long, weighing about 100 pounds.

The cost of refining by the iodide method is said to have been about \$50 per pound above the original cost of producing the sponge. The rate for the sponge, made with magnesium, must depend upon the cost of producing that metal. Reduction of any of these costs is influenced by the kinds of reactions possible with

the metals titanium, zirconium and hafnium. These were laboratory curiosities until 1940. Even now their chemistry is not well known. Contradictory statements are made by the men who are studying their properties, and many textbook descriptions are wrong.

As a challenging project, the winning of a continuous process for zirconium production leads the field. The material is not scarce. The metal is in highest demand. Its chemical properties are like practically no others, and thoroughly exasperating. No satisfactory electrolytic method seems possible. And at certain stages, the hard-won metal may catch fire

and burn up. A lifetime of hard work, or possibly a lucky accident, may solve the problem of supply of these super metals, and open a new volume in the annals of metallurgy.

Science Service is preparing a kit containing samples of zircon sand, zirconium oxide, zirconium sponge, zirconium carbonitride and zirconium wire. A booklet accompanying the kit describes simple experiments that can be performed with the specimens.

These kits will be available for the curious-minded at 75 cents each, or three for \$1.50, from Science Service, 1719 N St., N.W., Washington 6, D. C. When making request, ask for the Zirconium Unit.

### *On the Back Cover*

➤ ZIRCONIUM reduction is a batch process and as a result the small lots of sponge produced must be blended to form a composite of a ton or more. This is done by a special device called a blender which is built for the purpose. Shown on the back cover, it has a hopper above a rotating vibrating feeder. When the sponge lots are poured into it, one at a time, they go into a circular splitter of 30 compartments.

### *Clay Structure Like Polymers*

➤ MONTMORILLONITE, the highly absorbent clay used to soak up waste fission products for safe disposal, owes its great absorbent power to a network of the clay constituents and water molecules formed in somewhat the way plastics are built up by polymerization.

It is a peculiarity of these clays that on drying and kneading they become more liquid, while either exposure to

water vapor or heating makes them set to a jelly-like consistency. Studies on the behavior of such clays has led Drs. V. R. Damerell and E. Milberger of Western Reserve University to the conclusion that attractive forces between aluminum ions in the clays are the basis of the network formation. Their research on the unusually absorbent clay is reported in the scientific journal *Nature*.

## Atomic Weight Basis May Be Changed

► OXYGEN is one of the most familiar substances in the world. We could not get along for more than two or three minutes without it, because our lives depend upon our breathing it. Its weight is the standard for the atomic weights of all the chemical elements. Yet at the present time nobody is quite sure what that weight is. This is because chemists use one measurement, physicists use another, and the mass spectrograph gives still a different figure. The chemist might say that the weight is 16 or is 16.0044. The physicist might say 15.9956. The mass spectrograph would reveal three isotopes with weights of 16, 17 and 18.

All the figures are correct, and there is no disagreement about who is right. The differences depend upon which standard is chosen, and have gradually become more troublesome over a number of years. As recently as 1931 an attempt was made to choose between the oxygen of the chemists and the oxygen of the physicists, and the decision was reached that reconciling them was not important. But accuracy down to very fine distinctions has become increasingly important in the meantime, and the difference between the two measurements amounts to three parts in ten thousand. This is of the order of three cents in a hundred dollars. Bank depositors would expect their accounts to be kept accurate to this amount.

Atomic weights are so important

to chemists' calculations the world over that a Commission on Atomic Weights is maintained which reports to the International Union of Pure and Applied Chemistry at Zurich, Switzerland. The Commission has just submitted a report in which the atomic weights of twelve elements are revised, changing in each instance a figure in the first or second decimal place from the amount agreed upon in the previous official list, adopted in 1953.

Such changes are made fairly frequently, and usually concern rare elements. Such metals as dysprosium, gadolinium and samarium, and the inert gas xenon appear in the new list, and changes in their atomic weights upset very few chemical apple carts. But the new report takes up also the thorny question of whether oxygen 16, the stable and most abundant isotope, should be the standard for calculation of atomic weights of other elements, or whether traditional practice of using ordinary oxygen, in which there is a mixture of the three isotopes, be continued. The physicists use the isotope O-16 as their standard, but not nearly as many physicists as chemists are concerned. Chemists use 16.0000 for the atomic weight of the oxygen in the atmosphere. This was adopted as a compromise measure long before isotopes were even dreamed of. Now it turns out that, by the chemists' calculations, pure oxygen 16 would weigh

only 15.9956. The Commission finds the situation confusing.

"The practical difficulties," the report says, "involved in making this kind of transition from the present dual system to a single scale are considerable. If such a transition is made, there will be an inevitable period of confusion while those whose accustomed numbers have been discarded get used to the new ones.

"Above and beyond this will be the hard necessity of revising all important references and data related to the scale that is to be abandoned. On both scores it would seem that abandoning the chemical scale would involve much the greater difficulty.

"One need only consider the very large number of chemical textbooks, reference works, and handbooks, in all of which atomic and molecular weights form an important part of the content. In addition, there exists in the periodical literature a very large number of relatively permanent physico-chemical data reported in terms of gram equivalents and moles, and of concentrations referred to these quantities. Many of these data are sufficiently accurate so that a systematic change of nearly three parts in 10,000 could not be disregarded.

"By contrast, data based on the physical scale are still undergoing frequent revisions, and the number of scientists who use them must certainly be much smaller than those who use the chemical scale."

Choice of a standard for atomic weights is necessary because these quantities are expressed as multiples of the unit weight of hydrogen, lightest of the elements. The relative

weights are calculated by simple proportion from the weight in grams of the elements which combine to form stable and well understood compounds. Since elements combine atom by atom, it would be logical to expect the weights of the elements themselves to be in some simple proportion to one another. Chemists worried for nearly a century over the fact that, compared to hydrogen, the atomic weights of the elements are not whole numbers.

Until the discovery of radioactivity in the closing years of the 19th century, the fractional parts of the atomic weights of the elements were a complete puzzle to chemists wrestling with the theory of the atom. The more carefully the chemical procedures were carried out, the more persistently the fractions showed up in the calculations. The fact that many of the fractions were small gave the scientists the idea that, by using some other element than hydrogen as the base for the calculations, the trouble of multiplying and dividing by the fractions might be reduced. Chemists like short cuts as well as other people.

And so it came about, through international agreement, that the atomic weight of oxygen was chosen to be represented by the number 16 exactly. This shift of base brought many atomic weights of other elements closer to round numbers, although it caused hydrogen to be counted as 1.008.

Chemists got along quite well with this set of atomic weights, which they believed to be the most constant and most important property of the elements, the building blocks of which the world is made. They bent

their best efforts toward more and more exact determinations of the fractional parts of these weights.

Two events just before the First World War changed the whole problem of atomic weight determination. One was the discovery of isotopes by Frederick Soddy in 1913, the other the discovery of atomic numbers, as indicated by groups of lines in the X-ray spectra of the elements, by Henry J. G. Moseley at about the same time.

When careful examination of the products of radioactive disintegration showed that samples of an element from different sources may have slightly different atomic weights, although chemically the samples are indistinguishable, chemists had to change their ideas about the fundamental importance of the unique weights of each element. Soddy, who worked with Sir Ernest Rutherford, and Sir William Ramsay in early studies of radioactivity, coined the name isotope for the variety of an element which is conventional in chemical properties but out of line in respect to its weight.

Another kind of non-conformity among the elements was explained by Moseley, later killed at the Battle of Gallipoli. He found, among the spectral lines produced when X-rays were diffracted by crystals, a pattern of lines recognizable for every element but shifted from shorter to longer wavelength according to the atomic weight of the element. This regular shift of the lines provided the way to prove the correct sequence of the elements, and settled an argument which had persisted since the first attempts to classify the elements

according to their weights and properties.

In spite of the most careful efforts to determine atomic weights correctly, several pairs of elements were known to hold exceptional places in the periodic table. Potassium, for example, a typical alkali metal, was lighter than argon, one of the inert gases of the air. Apparently their weights should be reversed. Yet the weights were not in error, and exchanging the places in the table of two elements with such unlike properties was out of the question.

The two discoveries of 1913 solved the puzzle. The reason the atomic weights seemed wrong was because each of the elements has more than one isotope. It just happens that a lighter isotope of potassium is more abundant in nature than its heavier ones, while argon's chief isotope happens to be a heavier one.

As long as isotopes were largely scientific curiosities, there was no objection to the current method of figuring atomic weights. So far as anyone knew, there was only one oxygen and its weight was 16.

However, in 1929, the existence of two other isotopes of oxygen of weights 17 and 18, was discovered. Together they make up only about one-fourth of one percent of the oxygen in the air. Yet this is enough to affect calculations based on O-16 as the standard for the atomic weights of all the other elements.

This is the basis for the dilemma now being considered by the Commission on Atomic Weights. Two courses of action are possible. One

is to go on as before, with the chemists using the value based on natural oxygen, with its small but important mixture of isotopes, and the physicists using the pure O-16 isotope. The physicists are more logical but the chemists have the greater volume of accumulated data to cope with. The other course is to change the reference material from oxygen to some other element if one could be found which would entail less confusion.

"The alternative of abandoning both existing scales and establishing a new one," the Commission's report continues, "should not be dismissed without consideration, especially if a reference mass weight could be chosen that has no logical or practical disadvantages and that would minimize the revision of published material.

"In the 1931 report of the International Commission two possible new scales were mentioned.

"One used the exact number 1 as the relative mass of hydrogen 1. Adoption of the hydrogen scale would change all data relating to the masses of atoms by about 8 parts in 1000 — perhaps a sufficiently drastic change to minimize the resulting confusing.

"This scheme would also put an end to those curious quantities — negative mass defects — which are now attributed to the great majority of all nuclear species. However, on this scale the mass defects of the heavier elements become so large that the familiar and useful 'mass numbers' would be displaced from the atomic masses of the respective nuclides by as much as two units....

"A scale based on fluorine 19, with an assigned exact mass of 19, would

appear to offer more attractive possibilities. In the current International Table the atomic weight of fluorine (which has no known natural isotopes) is given as 19.00, but its more exact value is  $18.9992 \pm 0.0002$ . The adoption of the exact number 19 for fluorine therefore would shift all numbers related to the current chemical scale upward by only about one part in 25,000. A change of this magnitude could be neglected for most of the data of chemistry, and the formal revision of books, etc., could proceed leisurely, with little confusion.

"On the current physical scale the mass of F-19 is 19.0044. A change to 19 would shift all masses on the physical scale downward by about two parts in 10,000, an amount that would, of course, necessitate revision of all tabulations. Provided it offers no insurmountable obstacles for intercomparison with the masses of other nuclear species, a scale based on F-19 = 19 might be more acceptable to physicists than one based on a non-integral value such as 15.9956 for O-16."

Dr. Edward Wichers of the National Bureau of Standards, author of the Commission's report, suggests that agreement be reached by responsible members of the scientific professions involved, and that, if a change in the standard for atomic weights is to be made, the date for changing it be set far enough in the future to allow time for revision of the reference books and other publications concerned."

"It remains only," Dr. Wichers concludes, "to repeat the invitation to all concerned to give the problem through and objective consideration."



► WILLIAM HENRY PERKIN (1838-1907), creator of the first synthetic dye, mauve, in 1856. Many years after his original discovery, honors were heaped upon him, including knighthood.



## A Century of Color

► THE ENTIRE DYE industry and the world of chemistry is celebrating the 100th anniversary of the discovery of mauve, the first synthetic dye, by William Henry Perkin in England in 1856.

The modern dye industry began with the discovery of mauve. This was done accidentally by Perkin when he was just 17 years old, while he was experimenting in an attempt to synthesize quinine. During one experiment in which he was using aniline, a product of coal tar, as one of the raw materials, a dark colored mass was formed. This was mauve, the first of the many colorful aniline dyes, which is now prepared from black, sticky, foul-smelling coal-tar. When this mass was dissolved in alcohol, a violet liquid resulted which would dye silk and wool.

Perkin pursued his experiments until he had the chemical process under control, patented it, and established in England the first factory in the world for the manufacture of dyes.

The discovery of the first synthetic dye was much simpler than its production on a commercial scale. Aniline oil, which was needed for the manufacture of mauve, was not available. When Perkin attempted to produce it from coal tar, he found this was not practical. He then developed a new procedure of obtaining aniline oil from nitrobenzene. While working out the best process for producing the dye, several explosions occurred.

Eventually most of the difficulties were overcome and the first lot of mauve was commercially available in December, 1857.

During the next ten years, Perkin continued research on dyes and improved on his original mauve by a different chemical procedure. He also brought out other dyes known as Perkin's green, alizarin, Dahlia, aniline pink, magenta, etc.

This 100th anniversary of the creation of synthetic dyes is culminating in New York City the week of Sept. 10—16 during the Perkin Centennial, sponsored by the American Association of Textile Chemists and Colorists.

Synthetic dyes are usually made from one or the other of five hydrocarbons, benzene, toluene, xylene, naphthalene and anthracene. The best source for these hydrocarbons is coal tar, obtained from the high temperature heating of coal for the manufacture of illuminating gas or of coke. The hydrocarbons thus obtained are usually separated from other compounds and from each other by heating and then purified further.

The various dye stuffs are built up from these hydrocarbons in successive stages until a very complex molecule has been made. It is possible for the color chemist to build up dyestuff molecules having almost any required structure and containing the particular atomic groupings which are

known to produce the properties desired.

The art of dying is employed to affect materials so that the colors will not be readily removed by those influences to which they are likely to be submitted, such as washing, rubbing, light, etc.

The use of color began with the dawn of civilization. The earliest dyes, possibly discovered by accident, may have been stains from berries, fruits and nuts used as food. Later, flowers, leaves, stems and roots of shrubs, bark and twigs of trees were discovered as sources of dyes. This art seems to have developed independently among primitive people of almost every country.

At first dyestuffs of vegetable origin, available in the neighborhood, were used exclusively. The dyer merely collected flowers, berries, leaves, bark or roots in nearby fields or forests and boiled them in water. Colors were limited pretty much to red, yellow, green, blue and brown; few variations in shades were possible.

Dyes have been extracted at one time or another from hundreds of different flowers, trees and shrubs. But experience showed that some were more satisfactory than others—sometimes because the color was more brilliant, sometimes because it lasted longer. As dyestuffs found in one district were recognized to be superior to those of another, trade began. Eventually many of the dyestuffs used in ancient times were discarded, so that only a few survived.

Natural dyes are seldom used today. Chemical dyes, discovered in the last century, have proved so popular that there is little demand for the

old time favorites such as indigo (blue), madder (red), woad (blue), logwood (purple), fustic (yellow), and turmeric (yellow).

European chemical manufacturers quickly seized the opportunities opened by Perkin's discovery of synthetic dye. Germans particularly learned from the British and built with government support an industry that until 1914 had a virtual monopoly on the manufacture of dye. When foreign sources of dye were cut off from the United States during World War I, chemical manufacturers in this country began making dyes. Today America has a dye industry that is unsurpassed.

Research in dyes is continuing and new types are still being developed. At the present time there are well over 1,000 separate dyes which include all the colors of the spectrum, with degrees of fastness capable of meeting almost every normal requirement.

The dye industry has contributed more than color. Research in dyes developed a whole array of important organic chemical products. Explosives which increased ability to wage war arose out of research on nitrated compounds close in structure to dyes. Many photographic chemicals, perfumes, flavorings and insecticides had their start in dye chemistry. Synthetic camphor, so important in the making of plastics and for medicinal purposes, was developed in a dye research laboratory.

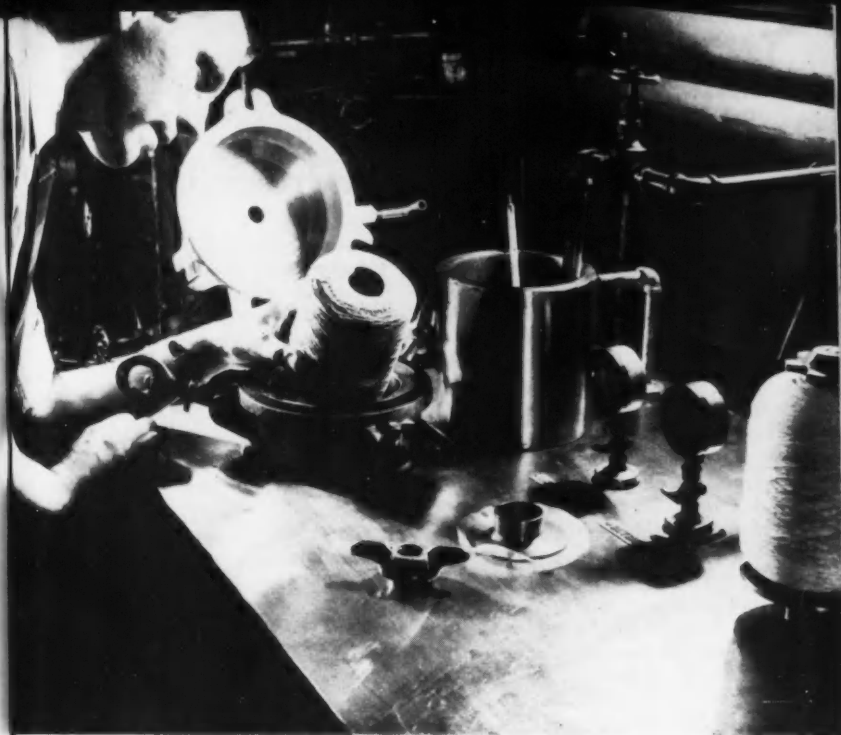
The raw materials and intermediate chemicals used in dye manufacture also provide a broad range of modern medicinal chemicals. Drugs of the "sulfa" family and atabrine,

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➤ **PACKAGE DYING MACHINE.** *Yarn is wound around a steel coil bobbin and placed over a circular tube in a cylindrical machine, and the cover securely bolted. Dye liquor is then pumped through the perforated tube and forced out through the cone, dyeing the yarn. This illustration shows one of the series of stainless steel package dyeing machines in the Du Pont Technical Laboratory at Deepwater, N.J.*

the anti-malarial, are notable examples.

Other new commercial products, although not directly related to dye research, are being developed as a result of engineering research and experience gained through dye production.

Science Service has prepared a kit containing a sample of Perkin's

mauve dye, a swatch of material dyed mauve, and an undyed swatch or material. There are also samples of four other types of dyes.

These kits are available at 75 cents each, or three for \$1.50, from Science Service, 1719 N St., N.W. Washington 6, D. C. When making requests, ask for the Dye Unit.

## Early Man Lacked Calcium

► WHEN STONE AGE man started living in caves and using tools instead of his teeth to capture and preserve food, human teeth began to deteriorate.

A survey of the microscopic quality of human teeth shows this, Dr. Reidar Sognaes of Harvard School of Dental Medicine believes.

Dr. Sognaes has examined teeth from Paleolithic Palestine, Prehistoric Greece, Predynastic Egypt, Ancient Iceland, Middle Age Norway and from Ancient Guatemalan and Pecos Indian (New Mexico) sites.

The oldest tooth specimens, from the Stone Age period in Palestine, showed the formation of poor dentin and poor calcification. All Old World teeth show poor calcification and this seemed to result from disturbances occurring during the early years after birth. In the Pecos Indian teeth (1100-1700 A.D.) 50% had cavities. The Pecos Indian teeth were very prone to faulty microscopic structure.

Stone Age teeth could be grouped with those of modern man with

respect to the range and severity of developmental defects in the dental microstructure, probably due to inadequate or irregular diet, Dr. Sognaes reports.

Defects in tooth development are exceedingly rare in such subhuman primates as the wild rhesus monkey, he notes.

This suggests that the primates maintained uniformly perfect tooth structure only as long as they were basking in the sun of the treetops, depending for survival upon the perfection of their teeth; that the terrestrial apes (subhuman anthropoids as the wild chimpanzees, gorillas, gibbons and orangutangs) tended to have teeth of an intermediary microstructure, less perfect than the monkey but superior to early man; and that early man proved too clever for his own good, dentally speaking, when he entered the cave and in the struggle for life discovered the use of other tools than his own teeth for the capture and preservation of food.

A new and unique high temperature resistant paint has been developed, designed primarily for the protection of diesel engine exhaust systems.

The properties of hydrogen peroxide, particularly 90% concentration and higher, make it a desirable propellant for submarines, rockets and missiles.

The fibrous residue of sugarcane that remains after crushing the stalks for juice, known as bagasse, can now help relieve this country's shortage of pulpwood for papermaking.

## Bufotenine Hallucinations Studied

► "A PLEASANT Martini feeling" and faces that turn the color of an eggplant if it were diluted are among effects of injections into the blood stream of the poisonous mushroom and toad skin poison, bufotenine.

Hallucinations of seeing vivid red, green and yellow spots looking as if made of fluorescent cloth are other of the mock mental disease symptoms reported by prisoner volunteers given the drug.

The studies were made by Drs. Howard D. Fabing and J. Robert Hawkins of Cincinnati and are reported in the journal, *Science*.

The same chemical when given to dogs causes splaying of the hind legs and "an unearthly howling" which may go on for almost two hours.

Bufotenine is in the narcotic snuff, cohoba, of the Indians of Hispaniola and South America and in the Mouch-more of the Koryaks and other Siberian tribes of the Kamchatka peninsula and the flugsvamp of the Vikings, Drs. Fabing and Hawkins point out.

The berserk rages of the ancient Vikings and the temporary ecstatic

states of depersonalization and hallucinations of primitive men who ate certain poisonous plants to produce these effects are now believed due to the bufotenine in the various plants.

The chemical has surprisingly little effect on either blood pressure or pulse rate, although one of the volunteers said he felt a tightness in his throat and pulse and a "racing pulse." His pulse rate remained at the basic 84 per minute.

Dilated pupils and nystagmus, with the eyes making involuntary fast movements from side to side or up and down, were other effects of the chemical.

One volunteer reported his mind "felt crowded," another that his mind felt better and more pleasant than usual. The one who reported the "pleasant Martini feeling" said he felt his body was taking charge of his mind.

Studies of this and other chemicals that produce mock mental disease are being pursued with the hope of learning more about possible chemical causes and remedies of mental sickness.

Columbium (which chemists now call "niobium") is an expensive and strategically important metal especially useful in the stabilization of certain stainless steels used for high temperature service by aircraft and other industries.

Semi-conductor silicon is neither a good insulator nor a good conductor of electricity, but the addition of exactly measured traces of certain impurities gives it the ability to control current flow.

## Irradiation Consequences Weighed

➤ How is your radiation level these days?

This is the kind of a question that the recent National Academy of Sciences inquiry suggests should be asked of everyone, for personal safety and the prevention of defective children in future generations.

In the atomic energy industry each worker carries a radiation badge, usually a bit of photographic film that is darkened by radioactivity he experiences. Inspected each week, it becomes a part of health and employment records.

In our atomic world, everyone may be asked to carry some such radiation recorder, to be inspected like one's car periodically, perhaps twice a year. Or it may suffice to require or have a personal X-ray record upon which is entered each medical exposure to radiation. For medical radiation, on the average, is about as responsible as natural or background radiation for building up the roentgen exposure. Radiation is feared both as a shortener of individual life and the source of future defective children when experienced by potential fathers, and to a less extent, mothers.

The Government has found it possible to keep a gigantic file of social security credits in dollars. Perhaps doctors and dentists will be required to plow into a similar file, or the same one, the unfavorable "radiation debit."

The prospective bride might be expected to ask for radiation informa-

tion on the intended groom, with such prosaic matters as money in the bank.

Under present conditions, people may not know when they are subjected to unusual radiation risks. Atomic radiation is undetectable by the ordinary senses. If there is an atomic explosion somewhere that drops fallout on a far-distant city, the inhabitants there will not realize they have been damaged unless monitoring stations spread the warning.

At present, a network of 40 observing stations of the Atomic Energy Commission and the U.S. Weather Bureau extends across the United States. These stations constantly monitor radioactive fallout, helping to tell when atomic bombs are tested. Their readings are so much more vital potentially to human health than temperature or rainfall that radiation figures might well appear in the daily weather summaries.

### Atomic Jobs After 40 Urged

➤ Jobs will begin at age 40 in the relatively hazardous atomic occupations of the future. This is one of the recommendations of the inquiry on the biological effects of atomic radiations made by the National Academy of Sciences.

Nine-tenths of the babies of the nation are born to parents younger than 40. For that reason, the amount of radiation exposure of most individuals above that age will not visit upon future generations the handi-

capped babies that radiation genetic damage causes.

For those younger who are potential parents, the average radiation that they already receive due to the natural background (radioactivity, cosmic rays, etc.) would have to be raised from five-fold to ten-fold to double the genetic damage of the future generations.

The inquiry found that medical radiation, X-rays, fluoroscopy, etc., produce in the male sex glands in 30 years about three roentgens, compared with 4.3 roentgens from natural causes. The roentgen is the unit of radiation and one dental X-ray delivers five roentgens to the jaw but only five thousandths of a roentgen of stray radiation to the sex glands.

The committee, while it did not pass on whether atomic weapons tests should continue, did point out that if continued at the rate of the past five years, the fallout in this country will add only about a tenth of a roentgen dose over 30 years. The inference is that atomic weapon testing can continue safely.

Altogether the 30-year dose on the gonads is now something like eight roentgens.

Individuals should not receive a total accumulated dose to the reproductive cells of more than 50 roentgens up to age 30 and not more than 50 roentgens additional up to 40, the inquiry advised. This much is not received under actual conditions even in the atomic plants, except in a very few accidental cases. The general population's exposure above natural background should be kept to ten roentgens in the first 30 years of life.

The scientists urged strongly that

doctors curtail as much as possible the medical use of X-rays. This is the most practical way they have found of reducing the radiation hazard to individuals and to future generations.

#### **Nature Against Radiation**

► DNA, THE STUFF genes are made of, is apparently well fortified against the effects of radiation by Mother Nature herself.

Studies at the Atomic Energy Project of the University of California at Los Angeles by Drs. Amos Norman and John Rowen have shown that a considerable difference exists in the way radiation affects DNA in the test tube and in its normal cellular setting. DNA is the abbreviation for the chemical name desoxyribonucleic acid.

DNA extracted from the cell and placed in a test tube was irradiated moderately. Sensitive instruments detected marked changes in the test tube DNA molecules caused by the radiation.

Cells containing the same type of DNA were then irradiated. No changes in the DNA could be detected by the same instruments, and no effects were apparent.

It is possible that the high concentration of DNA found in cells may itself serve as a protective measure, the investigators point out. The banding together of the molecules in a tight clump may minimize damage.

It is also possible that Nature has provided DNA with a "protein fortification" that will ward off fairly high levels of radiation. The DNA of viruses is surrounded by a protein shell which protects it. Cellular DNA may have a similar arrangement.

### Unborn Most Sensitive

► BRAINS of unborn babies would suffer most in massive radiation attacks such as A- or H-bombs. Adults on the other hand, have brains relatively resistant to radiation damage.

Non-secret research on the behavioral effects of ionizing radiation, reviewed in an American Psychological Association publication, allows these conclusions.

The central nervous system of the embryo is peculiarly sensitive to X-rays and other types of ionizing radiations, particularly at certain stages of development.

The adult brain and central nervous system, however, are relatively resistant, but the effects of radiation are damaging. Adults would probably die before their brains are harmed, unless for some reason only their heads were exposed.

Several researchers show that during the earliest pre-natal period (up to seven days for the rat, roughly equivalent to three month for the human baby), the death rate is high, but the brains of survivors are usually normal.

Later (8 to 15 days for rats, about 3 to 6 months for the human) the death rate is lower, but this is the most sensitive period for producing abnormalities. Among the defects produced are blindness, mental deficiency, microcephaly (pinheads), hydrocephaly (enlargement of the head) and other types of neural malformations. Commonest is microcephaly.

In a follow-up study made of 30 pregnant women who were exposed to radiation from the Nagasaki at-

omic bomb, four out of the 16 children who survived were mentally retarded.

The first attempts to find out the effects of radiation on learning were conducted in Pavlov's laboratory in Russia by Dr. M. I. Nemenow and reported as early as 1934. When the head of one dog was given a dose of 1,500 roentgens there was only a slight drop in his conditioned reflexes (primitive learning), but after an additional 2,200 roentgens, his conditioned reflexes practically disappeared.

In this country, Dr. Ernest Furcht-gott of the University of Tennessee, who reviewed the work in the Psychological Bulletin found in 1951 that radiation had practically no effect on the ability of rats to run a maze. He determined radiation had little effect on the performance of animals, except for a decrease in speed and activity probably due to general radiation sickness.

A possible exception to the damaging effect of radiation is seen in a German study of 120 mental patients who were given X-ray treatment directly on the brain. Immediate effects were numbness, apathy and tingling sensations in the head. But the next day they felt happy, active and generally tranquil. These effects were attributed to stimulation of the hypothalamus, with resulting effects on the emotions.

The biological effects of high radiations are due primarily to changes in the body cells through ionization, which is removal of electrons from the atoms.

The severity of the effect depends both on the total number of ions

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formed and on how they are distributed in the tissues. Beta and gamma rays produce from six to 11 ions per micron of tissue; 1,000 kilovolt X-rays, about 15, and those of lower voltage still more. Neutron radiation produces up to 9,000 ions per micron of tissue.

Severity of effect on mammals increases with density of the ions.

Nothing in the research reviewed by Dr. Furchtgott lends any support to the theory recently reported from England that atomic radiation increases intelligence in growing children.

## *Hydrogen Peroxide Powers British Sub*

► HYDROGEN PEROXIDE, usually thought of as a bleach for blondes, is being used to power Britain's latest experimental submarine, Explorer.

The underwater craft is thought to be the first stable ocean going vessel to use peroxide as fuel. In World War II, the Germans used the chemical to launch V-1 missiles, to drive the fuel pumps in V-2 rockets and to propel torpedoes. The Germans are also reported to have built five peroxide-powered submarines, but never put them in service because there was no peroxide.

A principal advantage of hydrogen peroxide for submarine propulsion is that no exhaust bubbles reach

the surface. The Explorer has a conventional diesel engine and a peroxide propulsion system. When hydrogen peroxide breaks up, it releases heat, which is one of the sources of energy. The resulting free oxygen combines with fuel, such as diesel oil, to produce both steam and carbon dioxide to drive the turbine.

Use of the peroxide is reserved for special bursts of speed in attacking and escaping. The Explorer will carry no armament, and will not take part in operations, but will be used for training anti-submarine forces.

The design team that developed the new submarine was led by Dr. G. H. Forsyth of Vickers Armstrong.

## *Atomic Fishing Industry Seen*

► ATOMIC AGE fishermen will have more fish to catch and better ways of catching them.

Atomic fishing devices envisioned by Dr. Arthur D. Hasler, University of Wisconsin hydrobiologist, include: Atomic refrigerated ships.

Huge, atom-powered refrigerated cannery ships which can stay at sea until their storerooms are filled from satellite fishing vessels.

Atomically-generated electric char-

ges which can knock out large schools of fish.

Dr. Hasler also described to the Joint Congressional Committee on Atomic Energy atomic energy's role in fishery research.

Radioactive isotopes are being used to tag fish so scientists can learn how to increase their numbers.

Radioactive phosphorus is helping Wisconsin scientists study lake bottom mud, in which fish food grows.

## Radioactivity Hazards

► THE GREAT non-genetic hazards of atomic radiation in the future, aside from A- and H-bomb war, are:

Accumulated radioactive waste products from world-wide atomic power industry, which may release more radiation than an atomic war.

Accidental explosions of atomic power reactors.

Contamination of man's food supply by radiation from atomic bomb fallout, particularly by the isotope strontium 90 which is deposited in the bones.

These dangers are pointed out in the National Academy of Sciences' recent study on the biological effects of atomic radiation.

The "hot" fission products from U. S. reactors in 1965 will total in radioactivity the equivalent of tens of tons of radium. The scientists urge that these wastes be kept out of the great network of ocean and air currents, food and water supplies, upon which man depends for life.

Atomic power plants should be sealed so that a run-away reactor will not cause a disaster, the report urges.

### Warn of Leukemia, Lung Cancer

► WARNINGS of a new leukemia danger and of a possible lung cancer danger from radiation appear in the British Medical Research Council's report on the hazards of nuclear radiation, a companion piece to that issued by the National Academy of Sciences in the United States.

Inhaling radioactive particles in the

fallout from atomic explosions or in the vicinity of nuclear reactors could, theoretically, lead to cancer of the lung, the British report points out.

The radioactive particles would not be uniformly distributed in the lungs but would tend to collect in small areas. These areas would then be subjected to a high dose of radiation "with the result that in the long run lung cancer might be produced in some people."

The British scientists point out, however, that this would be "extremely unlikely" to happen as a result of fallout except in conditions of actual warfare. So long as proper safeguards are used, it is not likely to happen in the vicinity of nuclear reactors.

The new leukemia danger is apparently real rather than theoretical, and one which medical men seem to have overlooked. It threatens patients with the joint disease, ankylosing spondylitis. The stiffening of the joints, particularly in the spine, has earned this condition the popular name, "poker spine."

The disease usually starts in early adult life and is about six times more frequent in men than women.

The leukemia danger comes from the X-ray treatment often given and which helps some spondylitis patients, even permanently halting the disease.

Spondylitis patients given this treatment developed leukemia at about 10 times the rate that would be expected if they had not had radiation treatment, the scientists report.

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This finding was made in a special study of hospital records of between 13,000 and 14,000 patients, all of whom had gotten X-ray treatment for spondylitis at some time during the period 1935 to 1954. Leukemia developed in 38 of these patients. This seems a small number until compared with the national death rates for leukemia over the same period. Calculations based on these figures showed the 10 times increased incidence.

No increased amount of leukemia was found in patients who had not been treated by X-rays.

The X-ray treatment for ankylosing spondylitis is usually given over the whole spine, so that a large part of the body is exposed directly to the radiation. Some patients have had to have more than one course of treatment. The treatment is so extensive that it "more nearly approaches whole body irradiation than that given for any other non-malignant condition." It was for this reason that the British scientists made a special study of it after finding that leukemia had been reported in two patients given X-ray treatment for the condition.

The possibility that patients suffering from this condition are unusually sensitive to X-rays cannot be ruled out, the report points out.

A theoretical possibility also exists that very small doses could be given spondylitis patients without danger of producing leukemia. This could not be told from the available records.

#### **Plants Take Up Radioactivity**

► TREES, grass and growing crops extract radioactive particles from the air. But whether this natural filtering

process is helpful or harmful to man is not yet known.

Evidence that vegetation collects radioactive particles was found at the Naval Research Laboratory in tests with cheesecloth and metal screens used to catch radioactive particles. Both the cloth and metal filters did pick up radioactive particles by a simple impact process, whereby the radioactive particles in the atmosphere, along with other particles, strike the filter's small fibers and stick.

Scientists now believe that this is the same process occurring in nature, where the fibers of plants pick up radioactivity from the air streams.

This plant filtering process presents scientists with an as yet unsolved paradox.

On the one hand, it is thought by some that any elimination of radiation from the atmosphere, no matter how slight, is beneficial to man. If trees and plants are filtering out radioactive particles, then they are protecting man.

On the other hand, by picking up radioactive particles, grains used to make bread might carry over some of the radioactivity and end up on the dinner table, or by the same token, grass eaten by cows may transfer some of its picked-up radioactive particles to milk that ends up in baby's bottle.

One of the problems faced by scientists in determining whether natural radiation filtering is harmful or helpful is the difficulty in measuring the amount of radioactivity that remains in the plant. The test screens, for example, proved to be only one

percent efficient. Just how efficient plants are has to be determined.

The scientists who reported their work with the screens in the journal *Science*, Dr. L. B. Lockhart Jr., I. H. Blifford Jr., and R. A. Baus, state that natural filters such as grass or trees may behave like many layers of filter fibers in removing activity carried by surface winds. In this case, the removal of particulates is fairly efficient and may account for a large fraction of the fission-product activity deposited on vegetation, particularly in the absence of precipitation.

It has been found that leaves of many plants are more radioactive than the rest of the plant. Part of this is due to radiostromium falling with rain onto the leaves. However, the natural filtering process may prove to be another factor why foliage has more radioactivity than other parts of the plant.

In addition to their value in studying plant radioactivity, the screens used by the Navy scientists may be excellent tools for studying radioactivity in the atmosphere. It is thought, too, that they will play an important role in studying air masses.

Resembling weather vanes, the screen filters are being used along the 80th meridian in South America to gain more knowledge of radioactivity and the effectiveness of the screens themselves.

#### **Cut Crop Intake of Waste**

➤ A POSSIBLE means of controlling crop absorption of a dangerous by-product of nuclear fission is indicated in the research of Wallace H. Fuller, associate biochemist and associate professor of agricultural chemistry at the University of Arizona.

Radioactive stronium, the most biologically hazardous product of an atomic explosion, will not contaminate food crops if the soil contains enough exchangeable calcium.

The more exchangeable calcium there is in the soil, the less stronium will be absorbed, Dr. Fuller's investigations show. Dr. Fuller emphasizes, however, that the total amount of calcium in the soil has nothing to do with this radiostromium uptake. What does count is the presence of exchangeable calcium available to plants.

Radioactive stronium 90 is considered exceedingly dangerous to plants and animals because it accumulates easily in tissues and because it has a half-life of 25 years. Concentrations of radiostromium in food crops will poison persons eating the contaminated foods. Accumulations of stronium in bones can cause bone tumors and possible injury to blood-forming organs.

Crops investigated were clover, beans, barley, wheat, lettuce, tomatoes, spinach, radish, and rye grass.

Dr. Fuller also found that radiostromium applied to leaves of plants was not transferred to other parts of the plants.

This lack of translocation is very important, Dr. Fuller points out. It means that under many circumstances contaminated crops that otherwise would have to be discarded or removed from the land could be used for food provided by their uncontaminated parts, without danger of radioactivity.

#### **Calcinator Disposer**

➤ A TECHNIQUE of carefully-controlled burning in calcinators, indoor incin-

erators, has proved effective in disposing of bulky combustible radioactive wastes.

This technique, which may be used by radioisotope clinics and laboratories, has proved effective at the Atomic Energy Project of the University of California at Los Angeles, according to Louis B. Silverman, chief of health physics at the project.

Radioactive wastes, which include animal and vegetable matter, are placed in a gas-fired calcinator. Eight to ten loads of waste may be burned before the calcinator ash drawer is removed.

Ashes are wet down and slurried with five to ten pounds of cement,

which solidifies and gives added weight, and are placed in a plastic-lined 55-gallon drum. When the drum is full, it is sealed and taken out to sea for "burial."

At the U.C.L.A. Atomic Energy Project, where much experimentation with long-lived isotopes is carried out, this technique has reduced sea burials of 55-gallon drums of waste from 50 or more drums to one a year.

Although more than 99% of the radioactive material remains in the ashes, the calcinator stack is monitored to insure that radioactivity remains within permissible levels. Radioactivity of the calcinator area has not been above the normal background radiation, the scientist says.

## *Radioactive Soda Bicarb Saves Holes in Street*

➤ A LEAKING water main under a main street no longer means traffic chaos in Britain, while laborers search with pickax and shovel for the fault.

City councils now call on Harwell atomic scientist, Miss Anne Wildblood.

In place of the pickax, 30-year-old Miss Wildblood works with an eight-foot, chromium-plated Geiger counter pole. Her atomic counterpart of the shovel is a handful of radioactive sodium bicarbonate tablets.

In jodpurs and riding coat, Miss Wildblood searches for leaks in water mains and oil pipelines.

The water in the mains is made harmlessly radioactive with the sodium bicarbonate. Then holes are bored in the road for Miss Wildblood to reach the mains with her Geiger pole. When it finds the spot where water has leaked it registers positive radioactivity. Only when the exact point of the leak has been found does the road have to be dug up.

## *All-Weather Air Conditioned Clothes*

➤ AIR CONDITIONED clothes designed to keep the wearer cool in the summer and warm in the winter have been produced in England.

The all-season garments are made from textiles treated with aluminum flakes suspended in resin. Linings of the material make lightweight coats

that resist cold winds and, at the same time, adapt to the temperature when worn indoors

In the future, it is reported, children and sportsmen may have clothes lined by the process; lighter winter boots and shoes; and sleeping-bags only half their present weight.

## For The Home Lab

### Tin

by BURTON L. HAWK

► THE COMMON reference to anything cheap as "tinny," has brought tin a reputation it does not deserve. In fact, tin is not cheap. It is becoming increasingly scarce and hence more expensive. It has been estimated that only 0.00001 per cent of the earth's crust is tin. Tin is very resistant to corrosion and is useful in protecting other metals through plating. It is also used to produce many alloys inculding solder, pewter, type metal and Rose's metal.

No one knows who first discovered tin. In one form or another it was apparently known to the Ancients. It is mentioned in the writings of Pliny and Dioscorides and in the Hebrew and Hindu Scriptures. In fact, Pliny even mentioned the use of tin as a coating to prevent corrosion of copper! Our tin plating is evidently not a new idea.

In 1868 a quantity of blocks of tin stored in the custom house in Leningrad mysteriously turned largely into a gray powder. Scientists were puzzled at this strange transformation of tin. Now we know that it is due to the fact that tin exists in three allotropic forms. At ordinary temperatures it is white malleable metal. Below 18 degrees it exists as a gray metal which is easily crumbled. Thus, articles made of pure tin are likely to disintegrate in cold weather. The third form occurs above 161 degrees and is a white metal, but very brittle.

Since tin has two valence numbers,

it forms two series of salts, *stannous* and *stannic*, when it performs as a metal. However, it also acts as a non-metal and produces the compounds known as *stannites* and *stannates*, which are salts of stannous acid and stannic acid.

To note the action of tin on acids, place five test tubes in a row. In the first, place a dilute solution of hydrochloric acid. In the second, dilute sulfuric acid; in the third concentrated sulfuric acid; in the fourth dilute nitric acid and in the fifth concentrated nitric acid. Drop a small piece of tin in each tube. If the action is slow, heat the two tubes gently. Tin reacts slowly with hydrochloric acid to form stannous chloride. If you care to prepare this compound, continue heating occasionally until most of the tin is dissolved. Filter, and evaporate the filtrate to obtain the crystals of stannous chloride. Tin reacts with dilute sulfuric acid to produce stannous sulfate; however, with the concentrated acid it acts as a reducing agent and sulfur dioxide is formed. With dilute nitric acid, stannous nitrate is obtained. With the concentrated nitric acid, the tin is oxidized and the insoluble meta-stannic acid precipitates.

Dissolve a small quantity of stannous chloride in water. The solution will probably be cloudy due to the insoluble basic salt which is formed. A few drops of hydrochloric acid should clarify the solution. Add a few drops of sodium hydroxide solution

to the stannous chloride. Stannous hydroxide is precipitated. When this precipitate is heated it is dehydrated and the oxide,  $\text{SnO}_2$ , is finally obtained. Thus, stannous hydroxide cannot be obtained in the dry state. Add more sodium hydroxide until the precipitate originally formed is redissolved. You now have a solution of sodium stannite,  $\text{NaSnO}_2$ . To another portion of stannous chloride, add a few drops of sodium sulfide solution. A brown precipitate of stannous sulfide is obtained. Stannous sulfide will dissolve in ammonium polysulfide solution to produce ammonium thioannate.

Stannous chloride is a reducing agent. Add a solution of stannous chloride to a solution of mercuric chloride. The mercuric ion is reduced to mercurous and a white precipitate of mercurous chloride is obtained. Similarly, ferric chloride is reduced to ferrous.

Stannic chloride is an unusual compound in that it is liquid at ordinary temperatures and in the pure state does not conduct the electric current, both contrary to the accepted nature of salts. It is prepared by the action of chlorine on tin. In the home lab, it can be prepared in small quantity by dissolving tin in nitro-hydrochloric acid. Carefully mix together three parts concentrated hydrochloric acid with one part concentrated nitric acid. Add a small piece of tin. Chlorine is released by the solution and acts on the tin. After action ceases, add a few drops of sodium sulfide solution. A yellow precipitate of stannic sulfide is obtained.

Tin forms two oxides, stannous,  $\text{SnO}$ , and stannic,  $\text{SnO}_2$ . The former is prepared by carefully heating stannous oxalate. It is a black or greenish-black powder. Stannous oxalate can be prepared by adding oxalic acid to a neutral solution of stannous chloride. Stannic oxide is prepared by heating stannous oxide strongly. It is a white powder when cold and yellow when hot.

The metal itself can be obtained by heating the oxide,  $\text{SnO}_2$ , with carbon. If you would like to try this, we suggest you use a blowpipe. Mix the oxide with carbon and place in a charcoal block. Heat in the reducing (inner) flame of the blowpipe. Since tin is rather far down in the list of metals, it can be displaced from solution by more active metals. Simply drop a piece of clean zinc, iron, or aluminum in a strong solution of stannous chloride and allow to stand for a few days. Scrape off the deposit and dry. Look for the tiny crystals of pure tin.

The action of potassium iodide on tin salts is rather interesting. Add a small quantity of potassium iodide to a concentrated solution of stannous chloride. A yellow precipitate is formed at first but continues to redissolve as long as the stannous chloride is in excess. When the potassium iodide is in excess, a thick dark orange precipitate is obtained. If more stannous chloride is then added, the yellow precipitate is again obtained.

Tin reacts directly with sulfur to produce stannic sulfide. This can be demonstrated in an experiment sometimes called the "mosaic gold" experiment. Thoroughly mix together equal parts of powdered tin and sul-

fur. Add about  $\frac{1}{8}$ th as much ammonium chloride and place the mixture in a crucible. Cover the surface of the mixture with a sprinkling of ammonium chloride, cover the crucible, and heat strongly for about ten minutes. The stannic sulfide will be deposited in beautiful yellow spangles on the crucible lid.

If you have been patient and have tried the foregoing reactions and have been unsuccessful, please do not blame the innocent publishers of CHEMISTRY! It may be all the fault

of your stannous chloride! If you have had the compound for a while, no doubt a greater part of it has developed into the basic oxychloride salt, which is insoluble in water. Sometimes, as explained above, a few drops of hydrochloric acid may clarify the solution. But if more acid must be added it will interfere with the reactions described. So, we suggest that you avail yourself of a *fresh* supply of C.P. stannous chloride before you attempt to perform the experiments.



► "How NICE, Mr. Pottleby. Some admiring employee left you a clock!"



## New Alloys and Materials

➤ A MAGNETIC MATERIAL that promises to revolutionize the use of permanent magnets has been developed by Westinghouse Electric Corporation scientists.

The material is manganese-bismuth that is virtually 100% pure.

A big advantage of the new material is that pure manganese-bismuth is ten times more resistant to demagnetization than permanent magnets now in use.

The new magnetic material can also be embedded in a plastic and then cut, drilled or shaped in any size or form. Expensive machining operations can be eliminated; magnets can be cast or molded, possibly even extruded, into any shape desired.

The magnets are made by grinding manganese and bismuth together under an inert atmosphere of helium gas to prevent spontaneous combustion. The mixture is then sealed in a glass vessel under low-pressure helium and caused to unite chemically at slightly less than 520 degrees Fahrenheit. The product is reground into a fine powder and embedded in plastic to make the finished permanent magnets.

Development of the new material was made by Dr. A. J. Cornish of the magnetics and solid state physics department of Westinghouse. It was initially supported by the U.S. Air Force Air Research and Development Command.

### Develop New Super Alloy

➤ A "MADE-TO-ORDER" super-alloy called Nivco, is the forerunner of a new class of metals that can be "tailor-made" to do a specific job.

As important as the alloy is itself, the research technique used to develop the alloy is perhaps more important, Westinghouse Research Laboratories researchers hinted. The process permits the "predesign" of a needed set of properties into an alloy before it is ever prepared, thereby eliminating the time- and money-consuming "cut-and-try" metallurgical methods now being used.

The new material, which is five times stronger than 12% chrome steel, resists breakdown when subjected to temperatures as high as 1,200 degrees Fahrenheit and mechanical vibration.

Although the exact ingredients of the new alloy were not disclosed, Dr. A. W. Cochardt, advisory metallurgist at the research center, said it contained principally cobalt and nickel and smaller amounts of five additional elements.

An immediate application for the alloy will be for high-temperature steam turbine blades.

The alloy resulted from mixing it first on paper by putting into the theoretical recipe all the characteristics wanted. To kill the effects of mechanical vibration, for example, the scientists controlled the magnetic arrangement of the atoms, before the alloy was actually prepared.

### **Sugarcane Waste Makes Paper**

► PAPER made from sugarcane can help solve the shortage of pulpwood for papermaking.

A fibrous residue of sugarcane stalks, known as bagasse, is already being made into newsprint. Now U. S. Department of Agriculture scientists at the Northern Utilization Laboratory, Peoria, Ill., have found an economical method for making other grades of paper from the waste product.

The new process separates bagasse fibers from the pith. This gives greater strength to the fiber for use in making fine bleached papers, stationery and packaging materials. Bagasse papers are stronger than softwood papers in all but tearing resistance. They are particularly suited for blending with wood pulps to make many different kinds of paper products. Even the waste from the process using sugarcane waste has a future. The pith, left over after the bagasse fiber is extracted, has an excellent ability to absorb blackstrap molasses. This makes the pith a convenient carrier for molasses used as feed, estimated at nearly a billion gallons a year.

More than 70% of the blackstrap molasses now produced in this country could be mixed with pith from waste sugarcane stalks, as an integral part of sugar production operations, to produce a solid, easily transportable, high-energy feed ingredient that livestock relish.

### **Filter By Molecule Size**

► FOURTEEN man-made minerals similar to the natural zeolites have been produced in an effort to learn exactly

how minerals can filter out gasoline-type liquids from a mixture of liquid hydrocarbons.

"Straight-chain" hydrocarbons similar to gasoline are known to pass through tiny channels in natural zeolite minerals while liquid compounds of more complex structure are held back. This filtering action is believed due to difference in size between the molecules of the complex liquids and channels left in the filtering minerals when water has been driven out of the crystals that make up the zeolite structure.

Beginning with an attempt to synthesize naturally occurring zeolites, the research laboratory of Linde Air Products Co., Tonawanda, N.Y., has succeeded in duplicating 20 rare natural minerals, making compounds which have the same filtering properties as those dug from the earth. In addition, the laboratory has produced 14 new minerals of similar type which have never been found in nature. The achievement was announced by three chemists, D. W. Breck, W. G. Eversole and R. M. Milton in the Journal of the American Chemical Society.

The man-made minerals are compounds of silicon and aluminum which, when combined with sodium or calcium, make rock-like materials similar to the zeolites used in water-purification systems. Analysis of the new products by X-rays has shown the Linde Co. chemists details of structure which give new insight into how these materials can separate liquids according to their chemical composition.

## Insect Resistance Increasing

► THE HOUSEFLY appears to be registering another victory over scientists in the continuing war of eradication. Danish scientists have found that flies, already DDT-resistant, are now developing an immunity to the more powerful phosphate exterminators.

In a report to the journal *Science*, J. Keiding of the Government Pest Infestation Laboratory, Springforbi, Denmark, says that although not all Danish flies are immune to the phosphate killers, any small increase will hinder eradication programs.

In 1955, he says, Danish farmers reported that many flies were not succumbing to the phosphate insecticides, such as parathion, Diazinon and Bayer 21/199. This was a reversal of their previous experience with the phosphate exterminators.

In laboratory tests, more than half of the brood of flies caught in a local pig sty survived a 20-hour exposure to Bayer 21/199. The flies also proved they could survive parathion and Diazinon, although to a lesser degree.

Danish scientists are optimistic about the continued use of the phosphate compounds, however, pointing out that the resistance of the flies is only moderate. The Danish scientist cautions, nevertheless, that increasing resistance may make housefly control difficult even with organic phosphate compounds.

There have been no similar reports of phosphate-resistant flies in this country to date. Scientists here have raised phosphate-resistant flies in lab-

oratories, but report that the insects' tolerance has always remained below critical levels. U.S. scientists say that farmers and householders will be able to continue using the phosphate compounds with success for some time to come.

### Normal Flies Resist DDT

► FLIES that are susceptible to DDT, as well as those that can resist the insecticide, are able to render small amounts of the poison harmless.

This finding by a British scientist may indicate that the difference between DDT-resistant flies and susceptible flies is one of degree and not of kind. In other words, all flies may be able to resist the insecticide to some extent, and those which are able to resist it better than others survive in larger numbers and produce more offspring, which inherit the resistance of their parents. Scientists have not been certain whether all flies have some degree of resistance, or whether it has been totally absent in some and present in others.

Entomologist A. B. Hadaway of the Colonial Insecticides Research Unit at Porton, Wiltshire County, England, exposed female houseflies to small amounts of insecticides at intervals of 24 to 48 hours.

Two series of experiments were run. In one, flies were given equal doses of insecticides at intervals of 24 to 48 hours. Different insecticides were tried on different groups of flies. DDT, dieldrin and Diazinon were

fully cumulative even after 48 hours, but gamma BHC was not. About half the gamma BHC had been rendered ineffective by the time the second dose was applied.

In the second series of experiments, smaller amounts of each insecticide were applied daily to individual flies, and the resistance of different age groups was checked.

The scientist concluded that, although the degree of resistance to different insecticides varies considerably, houseflies from a normal strain can eliminate, metabolize or store in a harmless condition some of the absorbed insecticide, provided that the dosage is sufficiently low.

Houseflies were found to resist gamma BHC most effectively, DDT second, then dieldrin and finally Diazinon.

#### **Hormone Hints at Insecticide**

➤ A POTENT new insect hormone, extracted for the first time, holds promise of an insecticide against which pests cannot develop resistance.

The hormone prevents metamorphosis, the process by which insects change form, as when caterpillars change into butterflies. Scientists have been able to prevent metamorphosis only by transplantation of living cells.

The hormone has been extracted from the abdomen of an adult male *Cecropia* silkworm. Dr. Carroll M. Williams said extracts of this hormone prepared using petroleum ether created freak insects which soon died.

Reporting his work in the British journal *Nature*, the Harvard University scientist said the petroleum ether hormone extracted was applied to the outside of an insect in the pupal stage of development.

The result, the scientist said, was an insect which was part pupa and part adult, and which soon died.

Flies, roaches and other pests have developed resistance to virtually every insecticide developed by science. Since it is unlikely an insect can evolve resistance to its own hormones, Dr. Williams says, the newly extracted hormone will probably be an effective permanent insecticide after it has been identified and produced in the laboratory.

Dr. Williams conducted his experiments at the Zoological Laboratory, University of Cambridge, England.

#### **For Mosquito Control**

➤ A SURVEY of mosquito control methods by Rutgers University entomologists, New Brunswick, N.J., reveals a trend toward "more permanent" controls than insecticides.

More permanent measures include swamp drainage, filling in marsh areas with earth, leveling off marsh areas, filling marshes with water and stocking them with fish which prey on mosquito larvae, and clearing out dense vegetation.

The survey included 120 mosquito control commissions in the United States and Canada. The commissions said they only resort to insecticides when permanent control is impractical or impossible. Most agencies no longer use highly poisonous chemicals which can endanger the health of mosquito control operators and the public, the survey showed.

The survey also revealed that mosquito resistance to DDT is becoming more general. The findings are reported by Dr. Joseph M. Ginsburg in *Mosquito News*.

## Teacher Shortage Stop-Gap

➤ A NEW national group will seek more effective training for teachers and students in basic subjects, especially English, mathematics, science, history, and foreign languages.

Operating as the Council for Basic Education, Dr. Arthur Bestor, professor of history at the University of Illinois, has been elected president, and Prof. Harold L. Clapp of Grinnell College has been made executive secretary for a year with offices in Washington. Dr. Howard A. Meyerhoff of the Scientific Manpower Commission is treasurer and temporary organizing chairman.

Support to the extent of \$114,000 has been secured from a foundation for a five-year program.

### Retired Scientists to Teach

➤ RETIRED ENGINEERS, scientists and professors throughout the United States may provide many cities with a stop-gap solution to their current teacher shortages.

At least one city, New York, is already seriously considering such a program to meet its shortage of science and mathematics teachers. Other cities, particularly with large universities and industrial establishments nearby, may soon follow suit.

Presently, New York City lacks 47 full-time science teachers needed to staff 235 science classes in high schools come this fall. This represents about six percent of the total number of science teachers employed in the high schools in New York City.

To correct this situation, Dr. Joseph W. Barker, a member of the Advisory Committee on Science Manpower, appointed by the New York City Board of Education, suggested that retired engineers, scientists and professors be employed part-time to meet the shortage.

The major stumbling block to the plan, however, is that the New York State Education Law, like many other states' education laws, requires a minimum of eight semester hours in professional education courses before anyone can be licensed to teach. As these courses are not required for most engineering and scientific degrees, nor for professors, most retired scientists could not meet the requirements.

Dr. William Jansen, superintendent of schools in New York City, said, however, "if, as Dr. Barker suggests, there are a considerable number of retired scientists and engineers under the age of 70, who are willing to come to the assistance of our high schools in this emergency, I will be happy to urge Dr. James E. Allen, New York State's Commissioner of Education, to consider modification of the present regulations in order to enable these men to teach on a part-time and emergency basis.

Manpower experts here feel that New York City's action might pave the way for other large cities to set up similar programs by which retired scientists will be allowed to

help guide their youngest successors along the path to a science career.

#### Summer Atomic College

► AN ATOMIC college for 60 of the nation's engineering professors was held this summer at the Argonne National Laboratory. It paves the way for the teachers to set up nuclear engineering courses in their respective colleges and universities this fall.

The eight-week summer school is known as the American Society for Engineering Education Nuclear Energy Institute. At the school, the college professors received:

1. A survey of the available sources of unclassified information in the atomic energy field and of laboratory

teaching methods particularly relevant to the field of nuclear power.

2. Some feeling of the interrelations of the many scientific and engineering disciplines involved in the successful design of a nuclear power enterprise.

3. A more detailed knowledge of some one part of the whole field, usually that part most closely related to his previous interest and experience.

The summer Institute was jointly sponsored by the American Society for Engineering Education, the National Science Foundation, the Atomic Energy Commission and Northwestern University.

### *New Rauwolfia Drug Tested*

► A NEW rauwolfia extract that may be useful either as a local anesthetic or in treating blood vessel disorders is being tested by Drs. J. D. Kohli and N. N. De of the Central Drug Research Institute at Lucknow, U.P., India.

The new drug is called rauwolscine. It comes from the snakeroot plant family that has given reserpine and other anti-high blood pressure and relaxing drugs.

Its important action is in blocking nerves which normally are stimulated

by the adrenal gland hormone, adrenaline or epinephrine.

In large doses, however, it produces psychic and sexual excitement in animals. In this respect it is like another drug, yohimbine. Chemically, it is alpha-yohimbine.

Whether in small doses rauwolscine can be used as a medicine is now being tested at the laboratories in India. Details of the work were reported in the scientific journal, *Nature*, published in London, England.

### *Phosphate Mining Machine Developed*

► A PHOSPHATE rock mining machine which eliminates blasting and yields more ore has been developed by the U. S. Bureau of Mines.

Called a "planer," the device chips out ore with pneumatic chisels. It is

designed for underground rather than open-pit mining.

The phosphate planer is lighter and less bulky than its cousin, the coal planer, now being used in several eastern mines.

## Heredity as a Chemical Combination

► THE OFFSPRING of viruses which have been taken apart, into their inorganic constituents, and put back together, into the most primitive form of living matter, breed true to form.

Announcement of this fact, which clinches the proof that the tobacco mosaic virus is the same after its reanimation as it was before, was made recently by Drs. H. Fraenkel-Conrat and Robley Williams of the University of California. The California scientists spoke at the McCollum-Pratt Institute's symposium on the chemical basis of heredity, held at Johns Hopkins University.

These scientists succeeded, in March 1955, in recombining the protein and nucleic acid of the tobacco mosaic virus to reconstitute the living organism. They reported this achievement to the National Academy of Sciences in October of that year.

Not enough time has passed to allow Dr. Fraenkel-Conrat and Dr. Williams to determine whether the virus offspring of the reconstituted colony will differ from the parent stock in the number and kind of mutant strains produced.

Plant viruses are noted for maintaining the function of reproducing their kind, a fundamental criterion of living matter, without having a supply of the life chemical known as DNA in their makeup.

DNA is the abbreviation for the chemical name desoxyribonucleic ac-

id. This chemical is found in the reproductive cells of plants and animals, and is believed associated in a fundamental way with the mechanism of heredity. In plant viruses a similar chemical compound, RNA, ribonucleic acid, is the main life chemical. The two compounds differ in the simplest form of their chemical constitution by only one atom of oxygen. Duplication of this simplest form of structure into polymerized molecules of large size is, however, a characteristic of living matter.

Experiments in building up nucleic acids in the laboratory by means of an enzyme extracted from bacteria were described to the symposium by Dr. S. Ochoa of New York University. This enzyme has the ability of linking together the component parts of nucleic acids through the phosphorus and the ribose sugar they contain. Through this reaction, Dr. Ochoa is able to study the differences in nucleic acids, which are due to the orders of sequence of the nucleotides of which they are built. He can vary the chemical groups in such life chemicals to include similar compounds not found in nature.

The fact that living tissues can take up substitute chemicals in place of nucleic acids but cannot use them as food gives hope of making immunizing chemicals in this way which may protect against communicable diseases or possibly find use in combating cancer.

### Gene Now Obsolete Term

► THE GENE as the carrier of a unit characteristic in heredity has become a mere ghost of its former self. Once it was pictured as the unit of chromosome structure, much like an individual bead in a string of beads. It is still, by definition, the unit of heredity. But it is no longer believed to be a blob of matter which will confer blue eyes or extra fingers upon the individual who happens to receive one specific section of a chromosome in the lottery of heredity.

As new techniques of scientific observation reveal fine structure of the chromosomes, which are the heredity-bearing parts of the living cell, the mechanism by which plants and animals reproduce their own kind is found to be increasingly complex.

The imaginary model which likens genes within the chromosome to a string of beads has had to give way to one more like a piece of rope. Coiled and twisted strands which are shown by the optical microscope, or suggested by structures seen there, can be magnified by the electron microscope. Here the individual strands are seen to be each composed of many bundles of fibrils. Each fibril has an outside shell around a central core. Whether the living fibril is like an insulated wire or a hollow piece of macaroni has not been found. Dimensions of these fibrils do not correspond to those calculated by the scientists who elaborated the gene theory a generation ago.

So much has the idea of the gene changed that the word was not used on the program of the symposium on the chemical basis of heredity

held this summer at the Johns Hopkins University by the McCollum-Pratt Institute. Instead, the physicists and geneticists, who joined forces there to discuss the latest findings on the subject, substituted the term "unit of heredity."

A handicap to scientists trying to identify objects seen through the two kinds of magnifying devices seems to be that some of the key structures in the reproductive cells are too small to be seen clearly through the ordinary microscope, where the distinctness of the image is limited by the size of the waves of light by which the image is seen.

At the same time the electron microscope, which is capable of much greater magnification because it sees by means of the electron, finds the units of heredity in the cell too large to get into the picture. Scientists are now trying to identify objects of intermediate size which can bridge the gap satisfactorily between the two classes of structures.

### Life Still a Mystery

► LIFE is still a mystery. In spite of the strides taken in recent years toward understanding in detail the way life processes work, scientists have not been able to create life.

The goal of making living matter in a test tube seems to recede further with each new discovery. New problems appear as each barrier is overcome.

But scientists do know that life is a chemical reaction. Living cells are kept going by a continuous supply of the familiar food chemicals, proteins, carbohydrates and fats. The cells contain, in addition, nucleic acids.



The make-up of the cells by which life is maintained and passed on from one generation to the next was discussed at the Johns Hopkins University conference, under the auspices of the McCollum-Pratt Institute, with the cooperation of the Atomic Energy Commission.

Scientists have analyzed nucleic acids and have discovered that they are made up of four kinds of nuclear fragments. All four contain phosphoric acid and a peculiar kind of sugar called ribose. Four nucleotide bases, joined to the sugar and the phosphoric acid, make the distinction between the four constituents of nucleic acid.

The four nucleotide bases are nitrogen-containing compounds known respectively as adenine, guanine, cytosine and uracil. These are rather simple compounds as organic chemicals go. All have been synthesized from inorganic material, although for experimental work it is more convenient to obtain them by splitting nucleic acid.

Ribose, the sugar part of the nucleic acid, is chemically a simpler compound than dextrose and levulose, the less complex of the sugars used as food. Dextrose and levulose have six carbon atoms to the molecule. Ribose has only five. Its hydrogen

and oxygen are in standard carbohydrate proportions,  $C_5H_{10}O_5$ .

Although the ribose and the phosphorus parts of the nucleic acids are always the same, and the same four nucleotide bases are found in equal quantities on analysis, a great variety of ribonucleic acids is found in nature. The differences between these substances are believed to be due to differences in sequence of the nucleotides, in their arrangement within the molecule.

Experimenting chemists have tried the effect of introducing other, similar molecular groups into the nucleic acid structure in place of adenine or others of the nucleotide parts of ribonucleic acid. Such a synthesis is chemically practicable, but, when the new compound is introduced into a colony of bacteria, growth of the bacteria is hindered.

One school of cancer-fighters hopes to find a new way to control such morbid growths by administering abnormal chemicals of this type. The hope is that a compound could be synthesized which would be taken up preferentially by the cancer tissue, but which would then block the path by which the cancer tissue receives nutrients. A satisfactory compound of this nature has not yet been perfected.

## *Teach Girls Food Must Be Enjoyed*

► Food must be enjoyed, students at Florida State University are taught in their course on family meal planning.

So, in addition to learning to keep nutritional needs and cost in mind when planning family meals, the students analyze factors such as color,

texture, flavor, temperature, palatability and other esthetic points including equipment used for table setting.

The course was described by Dr. Helen Cate of the university at a recent meeting of the American Home Economics Association.

## Survey Describes Uranium Reserves

► THE UNITED STATES has reserves of fissionable materials which far exceed scientists' previous expectations, according to a U.S. Geological Survey report.

The study, which represents 12 years of research by the Geological Survey and the Atomic Energy Commission, is chiefly concerned with the geology of uranium and thorium and prospecting methods.

Called Professional Paper 300, the project includes 89 reports by 133 scientists, compiled by Lincoln R. Page and Harriet B. Smith of the Geological Survey and Hobart E. Stocking of the Atomic Energy Commission. About 75 of the reports were presented in Geneva at the 1955 U.N. Conference on Peaceful Uses of Atomic Energy. The remainder are presented for the first time in Professional Paper 300.

One report in particular, "The Analytical Chemistry of Uranium and Thorium," by Frank S. Grimaldi of the Geological Survey, is expected to be highly useful in speeding up analysis of ore samples.

Dr. Grimaldi, who is known for his research in analysis of rare elements in trace amounts, says his study is a product of many men's efforts. The work shows several fast methods of mineral extraction.

Drill companies can not afford to wait for long periods between drillings, Dr. Grimaldi says. A method had to be developed to isolate thorium selectively and rapidly.

Dr. Grimaldi reports a fast way of extracting thorium from solution with a solvent. Uranium isolation with fluorescent analysis, a development in which Dr. Grimaldi pioneered, is also described.

Concerning the U.S. atomic resources, the report shows:

Uranium minerals and uranium in unidentified form exist in nearly all types of rocks in the U.S.

Almost all domestic production comes from Colorado Plateau of Colorado, Utah, Arizona and New Mexico, and from Wyoming, South Dakota and Washington State. From July, 1953, to January, 1954, 80% of domestic yields came from the Colorado Plateau.

In eastern United States, uranium is widely distributed in Chattanooga shale in Tennessee, Kentucky and Alabama, in land pebble phosphate deposits in Florida, and in a variety of rocks in North Carolina, New York, New Jersey, Pennsylvania and New Hampshire. In the Midwest minor occurrences are known in Missouri, Arkansas, Michigan, Kansas and Oklahoma.

### Mineral Fuel Research

► THE U.S. Geological Survey has been granted \$28,095,000 for fiscal year 1957 for geology research, mapping, investigating water resources and supervising mineral leasing.

Survey research will emphasize geological mapping and mineral in-

vestigation, vital to the nation's expanding fuel and construction requirements. Scientists will try to uncover new knowledge of mineral and fuel deposits and new ways of searching for these resources. Geologists and chemists will attempt to develop a scanner which can quickly reveal the geochemical pattern of large tracts of country. Research will be started on the use of sound vibrations to discover mineral deposits buried at moderate depths.

The Survey and individual states will engage in the largest cooperative water resource program undertaken since the Geological Survey was founded. A corps of trained flood specialists will collect data on flood use for rehabilitation and basin developments for years to come. The quantity, quality and location of the nation's water resources will be appraised. Investigations will include stream flow, chemical content of water, ground water levels, sediment discharge and temperature.

Maps will be expanded and revised to correspond with highway, railroad and building developments in large areas of the country. Mapping projects will also be carried out in Alas-

ka, Hawaii, Puerto Rico and other island possessions.

One of the largest and most inaccessible areas of Alaska, the Brooks Range near the Arctic Circle, will be mapped by engineers using airplanes, helicopters and two-way radios.

Survey scientists will investigate oil resources in the following states: northwestern New York, central Texas, the McAlester Basin of eastern Oklahoma and the Anadarko Basin in western Oklahoma, the Ouachita Mountains in northern Arkansas, Wilson County in Kansas, the Sumatra-Alice Dome in Montana, southwestern Wyoming and the central Nebraska Basin.

The scientists will look for metals and mineral fuels (coal, oil and gas) in the following areas: the Republic district of Washington State, the Yellow Pine and Mackay districts in Idaho, the Duck Creek Pass area in Montana and the Bingham copper mining district in Utah.

Geological mapping will be undertaken in the Humboldt, Stillwater, and Snake Ranges in Nevada, the Bullfrog area of Nevada, the Blue Ridge and Piedmont Regions of North Carolina, and northern Maine.

## *Alcohol Vapors Stop Potato Sprouts*

► VAPORS of alcohols in a variety of concentrations will keep potatoes from sprouting.

English scientists suggest in the British journal *Nature* that farmers will find vapors of all alcohols more practical than suppressant dusts because alcohol vapors are effective even after signs of sprouting have been observed.

Extending past research with ethyl alcohol, W. G. Burton and R. J. Gibbs tried using a variety of alcohol vapors on potatoes. The Department of Scientific and Industrial Research scientists exposed three different varieties of potatoes to concentrations of 10 different kinds of alcohol vapors. All were found effective.

## The Romance of Uranium

by JESSE C. JOHNSON

Director, Division of Raw Materials U. S. Atomic Energy Commission

*Extracts from a talk before the American Institute of Mining & Metallurgical Engineers, New York, N. Y.*

► URANIUM prospecting has attracted more people, including people without mining experience, than any other mining excitement since the 1849 gold rush in California. Probably more prospectors and small operators have made fortunes or sizeable stakes during the eight years of the uranium program than in any similar period since the gold rush days.

The widest publicity given to sensational success stories is in no small measure responsible for the rapid expansion of uranium production in the United States and Canada. Less spectacular, but also important, have been the metallurgical developments. Long sought difficult answers have appeared at some of the most critical times.

Perhaps the most romantic period of the uranium search was in the cloak and dagger days of the Manhattan Engineering District. The atomic bomb project was developed by the supersecret work of the scientists and this two billion dollar project was undertaken without first having made commitments for the basic raw material — uranium.

For years there had been only two uranium operations, the Shinkolobwe Mine in the Belgian Congo and the Eldorado Mine in Arctic Canada. Both produced uranium as a source of radium for which the market was limited. The Sinkolobwe Mine, which had closed just before the war, was by far the more important of the two. It is approximately 1400 miles by rail and river and rail again from an ocean port. The Eldorado Mine, at Great Bear Lake, is 1600 miles from railhead. Transportation by lake and river involves seven transfers from lake vessels to river crafts, to trucks for by-passing rapids and finally to railroad cars 350 miles north of Edmonton. For nine months of the year, even this water route is closed by ice.

These two mines and the low-grade tailings at the vanadium mills on the Colorado Plateau were the only known uranium sources in 1942.

One of the first moves of the Manhattan Engineer District was to urge the reopening of the Shinkolobwe Mine in order to get a supply of high-grade uranium ore. Mr. Edgar Sengier, head of the great Union Minière mining enterprises, had moved to New York just before the Germans occupied Belgium. Colonel Kenneth D. Nichols, later Major General and recently General Manager of the At-

omic Energy Commission, was given the job of approaching Mr. Sengier.

On September 18, 1942, Colonel Nichols met Mr. Sengier in his New York Office. Before the conversation had proceeded far Mr. Sengier said: "If you are looking for uranium, I have some on Staten Island." Colonel Nichols left Mr. Sengier's office a few hours later with a contract — written on a piece of yellow paper — for the largest single lot of uranium purchased during the war period.

About 1939, Mr. Sengier had learned from European scientists about the possibilities of releasing nuclear energy from uranium. With characteristic foresight, Mr. Sengier decided to ship a sizeable quantity of the highest grade ore (about 65%  $U_3O_8$ ) to the United States just in case it might be useful during the war. Twelve hundred tons were shipped to New York and stored in a Staten Island warehouse. The shipment was cleared through customs in the usual way and was reported in the 1940 Bureau of Mines Year Book as uranium ore with a declared value of about \$1.35 per pound of uranium oxide content. Mr. Sengier told members of the State Department and other government officials about the shipment but the secret of the atomic bomb was so closely guarded that no one with whom he talked recognized the importance of the information.

This shipment supplied the bulk of the uranium for the development work and the early production of fissionable material for bombs. Subsequently, other shipments moved from the Congo, first material sorted from surface dumps and later from mining operations which were resumed

in 1943. Out of approximately forty wartime trans-Atlantic shipments only two were lost — both by submarine action. Canada also supplied important quantities of uranium. The mill tailings on the Colorado Plateau, processed under strict secrecy regulations, further contributed to the war supply of uranium.

All during the war, uranium was identified only by secret code letters. Your President recalls having presented to the RFC Board a contract which provided for the sale to the Army of X pounds of product Y at a price of Z dollars.

The biggest secret was not revealed until the bombing of Hiroshima. Then the world learned that man had found a way to release and use for destructive purposes the vast energy stored in the atom. In the mind of everyone who worked on the bomb, there was the hope that atomic energy would be an instrument for peace — that it might become the great source of industrial power.

It was the uranium atom that had been forced to yield its energy. Thorium was the only other element mentioned as a possible competitor. The possibilities of the fusion process were not discussed — at least not publicly.

No wonder uranium became the glamour metal. It received recognition from governments everywhere. Ironically, this recognition almost relegated it to the position of being the least sought of all useful metals. In many countries laws were passed nationalizing uranium — reserving to the government prospecting and production rights as well as ownership. Only because of the urgent need in

the post-war defense program were restrictions and regulations in a number of countries modified to encourage private prospecting and development.

Our Atomic Energy Act of 1946 reserved uranium to the government but gave the Commission rather broad powers for encouraging development and production. One of our difficult early tasks was to get legal concurrence that a valid mining location could be based upon the discovery of a mineral which the locator could not own. We finally cleared an announcement indicating that a valid location might be based upon the discovery of a uranium deposit. Legal concurrence was hedged by a "without prejudice" clause. Fortunately the Atomic Energy Act of 1954 removed this uncertainty.

There were other similar problems in early 1948 when we were planning the domestic and foreign uranium programs. Many wartime secrecy regulations were still in force. For example, a document showing the weight and uranium content of a shipment of ore was classified. We had to get that changed in order to buy a truck load of ore from a miner.

The Commission's 1948 uranium requirements were modest by today's standards. Nearly the entire quantity came from one mine, the Shinkolobwe. It was important to diversify and to assure a long-range continuing supply capable of expansion. Fortunately, our program was based upon this policy. As the big expansions in the atomic energy program developed, we were in position to say how and at what cost the required uranium could be obtained. Our es-

timates could not include uranium we hoped to find, but new discoveries became a dominant factor in the sources of supply and cost.

In 1948 the Shinkolobwe and Eldorado Mines, and the vanadium-uranium mines of the Colorado Plateau still were the only commercial sources of uranium, although the Manhattan Engineer District had conducted wide-spread undercover investigations. At that time reports on the Colorado Plateau were not optimistic about substantial continuing production. The Manhattan Engineer District had no program for ore production and discontinued operations on the Plateau after processing the accumulated mill tailings. It was thought that uranium might be only a by-product from vanadium operations.

In addition to these three sources, uranium also had been found in the South African gold tailings, in domestic phosphate rock and in the Chattanooga shale formations of Tennessee and adjoining states. These were all very low-grade materials. To recover one pound of uranium oxide it might require processing several tons of gold tailings or about five tons of phosphate rock or from ten to fifteen tons of shale. Processing problems appeared difficult and the costs high. However, each of these low-grade sources represented enormous uranium reserves. They offered the only opportunity for expanding production except for new discoveries. Consequently, a major effort was directed toward developing the most economic processes for utilizing them. South African gold tailings were by far the most attractive of the three be-

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cause of their chemical composition and grade and, particularly, because huge quantities were available for feeding directly into a uranium digestion system.

Although we expected new discoveries, we had no basis for predicting the rate or magnitude of discovery. The only thing to do was to attempt to encourage widespread private prospecting and development and to support and augment this with a large government exploration

program. This was done. Canada, at our request, undertook a parallel program. The domestic and Canadian programs were based upon the philosophy of the mining industry—given freedom of action and an adequate price structure, private industry will produce the metals. We now had the answer. The United States and Canada each soon will be producing more uranium than was expected from the entire Free World only a few years ago.

## *Chemical Probes Plant Senses*

► PLANTS can be fooled into not knowing which way is up.

A recently discovered chemical keeps plants from responding to gravity by checking their perception mechanisms, scientists at East Lansing, Michigan have shown.

Called N-1-naphthylphthalamic acid, the anti-gravity chemical gives science a new tool to study whatever sensory devices seedlings may have.

Michigan State University scientists working with U.S. Department of Agriculture researchers have discovered that the compound prevents

perception of gravity in plants. It does this, the investigators say, checking growth changes normally caused by gravity.

French scientists first showed that plant seedlings treated with the acid failed to respond to gravity.

Researchers suspected the compound inhibited growth, thereby making the seedlings indifferent to gravity. The United States scientists, Drs. Te May Ching and Robert S. Bandurski of Michigan State University, and Dr. Robert H. Hamilton Jr. of the Department of Agriculture, showed this was not the case.

## *Drug Brings Parkinson's Symptoms*

► A NEW DRUG that produces in animals symptoms similar to those of Parkinson's disease in humans is reported in the journal, *Science*.

The drug was discovered during the course of testing new chemicals on mice and later was tested on dogs and monkeys. It is called Tremorine,

and chemically is 1,4-dipyrrolidino-2-butyne.

It may prove fruitful to use Tremorine before testing other drugs designed to eliminate or control the symptoms of Parkinson's disease, Drs. G. M. Everett, L. E. Blockus and I. M. Shepperd of Abbott Laboratories, North Chicago, Ill., report.

## Chemical Inventions Newly Patented

*Order copies of patents by patent number from the Commissioner of Patents, Washington 25, D.C., enclosing 25 cents in coin, money order or Patent Office coupon for each. Do not send stamps.*

### Glass Shielding in Reactors

➤ A GLASS sandwich that protects atomic scientists from deadly radiation and, at the same time, permits the scientists to see what is happening in a nuclear reactor has been invented.

Its development may spell an end to the use of thicker lead and concrete shielding now used to protect atomic workers from dangerous radiations. Its use could also simplify some steps in the reactor operation because scientists could see more quickly when the reactor needed charging, or the fuel slugs needed replacement.

The glass shield is a laminate of two special glasses, separated by a third thin sheet of transparent glass with a high melting point. One layer, that closest to the atomic reaction, is made of the oxides of beryllium, lithium and boron. It slows down fast neutrons and captures slower neutrons. The second layer is a dense lead boro-silicate glass that absorbs beta and gamma radiations. Both radiation-stopping glasses are transparent.

The shielding was awarded patent No. 2,747,105 and its inventors, John V. Fitzgerald and George S. Bachman of New Kensington, Pa. assign-

ed the patent rights to the Pittsburgh Plate Glass Company.

### Manganese Alloy From Waste

➤ DR. EDWIN C. WRIGHT, head of the department of metallurgical engineering at the University of Alabama, has developed what he claims to be the first satisfactory process ever made for making ferromanganese having over 60% manganese from waste steel mill slag and low grade natural ores.

His process is a valuable contribution to the nation's metallurgical needs since more than 90% of the manganese used in the United States in steel making is imported. And similarly, 90% of the 600,000 tons of manganese used by the steel industry each year is discarded in waste dumps of slag.

To produce his alloy from lean manganese-containing material, Dr. Wright supplements a normal blast furnace charge with a sufficient quantity of such material to produce a pig iron containing five percent manganese. After smelting and bathing, the slag is then treated so as to reduce the manganese oxide to manganese. Dr. Wright was granted patent No. 2,746,857 for his invention.

### Decoration by Radiation

➤ GLASSWARE can be decorated by high energy radiation by means of a process invented by Carroll J. Billian of Toledo, Ohio. Mr. Billian was granted patent No. 2,746,193 and as-

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signed the patent rights to Owens-Illinois Glass Company of Ohio.

### **Chemical Cooling**

➤ **COLD DRINKS** for picnics without ice may be possible with the invention of a chemical cartridge to be inserted into each soda-pop bottle and activated for cooling the soda when desired. It is the invention of Evan D. Mills of Los Angeles, Calif., whose container-cooling device earned him patent No. 2,746,265.

### **Wine Finning**

➤ **FINING WINE**, the process whereby wine is made clear and tastier, is a closely guarded operation. In Germany, the law permits "blue" fining, wherein potassium ferrocyanide is added to the wine. This is controlled, however, so that no free cyanic compounds remain in the wine. "Blue" fining is prohibited, on the other hand, in this country, France, the Union of South Africa and Switzerland.

Now a German inventor has found a fining agent that he claims is not only better than "blue" fining, but completely eliminates the danger of overfining, the object of the laws prohibiting "blue" fining in the United States and elsewhere.

The secret as disclosed in the patent is the use of a group of compounds known as inositol. These compounds can be used if they are capable of forming complex compounds of heavy metals. They will effectively fine red wine, white wine and fruit wines and juices. The inventor, Kurt Hennig of Geisenheim, Germany, was granted patent No. 2,745,747.

### **CO<sub>2</sub> For No-Knock**

➤ **CARBON DIOXIDE**, responsible for the pop in soda pop, now has been found effective in taking the knock out of engine knock.

The discovery was made by Fred G. Rounds, Ralph E. Schwind and Lloyd L. Withrow of Detroit, Mich. According to the inventors, when carbon dioxide is mixed with engine fuel in controlled amounts, it is singularly effective in reducing engine knock, and also in cutting down the speed of the combustion reaction in spark ignition engines. The anti-knock carbon dioxide can be introduced at any point in the fuel-supply system. It can also be introduced continuously because it is relatively inexpensive and does not harm the engine.

The three inventors were awarded patent No. 2,747,560, and assigned the patent rights to General Motors Corporation of Detroit, Mich.

### **Atomic-Bred Flower**

➤ **THE WORLD'S** first patent for an atomic-bred flower has been granted by the U.S. Patent Office.

The flower is a pure white carnation. It was developed "accidentally" at the Brookhaven National Laboratory, Upton, N.Y., by Dr. Willard R. Singleton, Miller professor of biology at the University of Virginia, and Alan Richter, a graduate student at the University of Wisconsin.

As yet unnamed, the atomic age flower is a mutation brought about by subjecting a carnation known as White Sim to the gamma rays from a cobalt-60 source.

The White Sim, Dr. Singleton explained, has its white flower marred by red spots. During the course of

experimenting with radiation doses and the color of carnations, the mutation turned up.

What happened in their "accidental discovery," Dr. Singleton said, is that the red spots of the White Sim were eliminated. It is thought that radiation changed the underlying constitution of the carnation from a normal red into white.

Three generations of the flower have been raised and they have all bred true and pure white, Dr. Singleton points out. The new carnation has a flower that is two and one-half to three inches in diameter, is long-stemmed and without thorns.

The flower was awarded plant patent No. 1,481. Dr. Singleton assigned the patent rights to the United States of America as represented by the U. S. Atomic Energy Commission.

#### **Anti-Tarnish Wrappers**

➤ **ANTI-TARNISH** wrappers for protecting valuable silverware can now be made so they are long-lasting and do not release an acid, or turn dark.

Key to the protective wrapper is a chemical mixture invented by Daniel Gray of Sherrill, N.Y. The anti-tarnish wrapper can be made from either paper or cloth by impregnating it with an aqueous solution of a zinc salt of a weak acid, such as zinc acetate. Mr. Gray has discovered in his experiments that eight to 16 ounces of salt for each gallon of water yields a "very satisfactory product."

The wrapper material is first impregnated with the solution of the zinc salt of a weak acid and then dipped into an alkali. Silver wrapped in the treated cloth, Mr. Gray says,

"is preserved for long periods of time against tarnish." The wrapper can be cotton cloth, which can be laundered, tissue paper, kraft paper or cardboard. He was granted patent No. 2,749,210 and assigned the patent rights to Oneida Ltd., Oneida, N.Y.

#### **Rhenium Fabrication**

➤ **RHENIUM**, long a difficult metal to work, can now be fabricated into metal sheet or wire by a combination of cold-working and annealing, according to an invention that earned patent No. 2,749,260.

A relatively new addition to the world of metals, rhenium has resisted working because an oxide present in the metal melts at a low temperature during hot-work, or the metal cracks early during cold-work.

Now, Chester T. Sims of Worthington, Ohio, has invented a method for working the metal. It involves subjecting rhenium to a number of mild cold-working operations, with intermediate annealing steps, then subjecting the metal to more severe cold-working operations and longer time intermediate annealings. Mr. Sims assigned the patent rights to the Battelle Development Corporation of Columbus, Ohio.

#### **Isotope Separator**

➤ **DR. JOSEPH SLEPIAN**, assistant director of the Westinghouse Research Laboratories, Pittsburgh, Pa. received patent No. 2,752,503 for an electromagnetic isotope separator, which he claims can separate the isotopes of such elements as uranium and lithium with less power than is needed with gas diffusion separators.

## Book Condensations

ANALYTICAL EXPERIMENTAL PHYSICS — Michael Ference Jr., Harvey B. Lemon, and Reginald J. Stephenson — *University of Chicago Press*, 2d rev. ed., 623 p., illus., \$8.00. Revised edition of an established text intended for the serious student who expects to be a physicist.

CHEMICAL SAFETY SUPERVISION — Joseph Guelick — *Reinhold*, 221 p., illus., \$4.50. For the supervisor whose men work with chemicals, telling him what dangers he faces and how to prevent accidents.

THE COMMON SENSE OF THE EXACT SCIENCES — William Kingdom Clifford — *Dover*, 249 p., illus., paper, \$1.60. An inexpensive re-issue of a book used for 70 years as a guide to modern scientific and mathematical thought. The book includes prefaces and an introduction by James R. Newman, Karl Pearson, and Bertrand Russell.

ELEMENTS OF QUANTITATIVE ANALYSIS: Theory and Practice — Herbert H. Willard, N. Howell Furman and Clark E. Bricker — *Van Nostrand*, 4th ed., 576 p., illus., \$5.65. Revised to include as many new developments as possible.

THE FOUNDATIONS OF SCIENCE — Sheldon J. Lachman — *Hamilton Press*, 130 p., paper, \$1.50. Intended to be sufficiently simple and brief and broad to permit the college student to obtain quickly an orientation in the essentials of science as a constructive and creative enterprise.

THE GOLDEN BOOK OF SCIENCE — Bertha Morris Parker, illustrated by Harry McNaught — *Simon and*

*Schuster*, 97 p., illus., \$3.95. A delightful introduction to the world of animals, plants, rocks, stars and machines.

PRINCIPLES OF CHEMICAL ENGINEERING THERMODYNAMICS — Ernest D. Wilson and Harold C. Ries — *McGraw-Hill*, 376 p., illus., \$7.50. The authors are convinced that a working knowledge of thermodynamics is one of the most valuable assets that a chemical engineer can have.

THE QUANTITATIVE ANALYSIS OF DRUGS — D. C. Garratt — *Philosophical Library*, 2d ed., 670 p., illus., \$17.50. A reference work for manufacturing firms and others.

SEMIMICRO LABORATORY EXERCISES IN HIGH SCHOOL CHEMISTRY — Fred T. Weisbruch — *Heath*, 277 p., illus., paper, \$1.88.

THE THEORY OF SOUND — John William Strutt, Baron Rayleigh with a historical introduction by Robert Bruce Lindsay — *Dover*, Two volumes of 480 p., and 504 p., paper, \$3.90 for 2-vol. set. Students edition of a classic first published in 1877 and still of outstanding importance.

THE WONDERFUL WORLD OF MATHEMATICS — Lancelot Hogben — *Garden City Books*, 369 p., illus., \$2.95. A beautiful book, illustrated in color, showing the history of mathematics and its applications in our daily life.

YOUR WORLD IN MOTION: The Story of Energy — George Barrow — *Harcourt, Brace*, 181 p., illus., \$2.95. Describing for young people the endless activity that is going on all the time even where things appear most still to us.

## Proudly Presented

THE ABC'S OF MODERN PLASTICS: Basic Facts on the Sources and Production of Plastics, Their Spectacular Growth and Importance in Everyday Living — *Bakelite Company*, 45 p., illus., paper, free upon request direct to publisher, 300 Madison Ave., New York 17, N. Y.

THE ATOM IN OUR HANDS — *Union Carbide and Carbon Corporation*, 40 p., illus., paper, free upon request direct to publisher, 30 East 42nd St., New York 17, N. Y. A clear description of how uranium is separated to obtain the rare uranium 235 and also how the atom is put to use peacefully in medicine, industry and agriculture.

THE BIOLOGICAL EFFECTS OF ATOMIC RADIATION: A Report to the Public — From a study by the National Academy of Sciences — *National Academy of Sciences — National Research Council*, 40 p., paper, free upon request direct to publisher, Washington 25, D. C. The inheritance mechanism is by far the most sensitive to radiation and the effect is cumulative until the end of the child-bearing years.

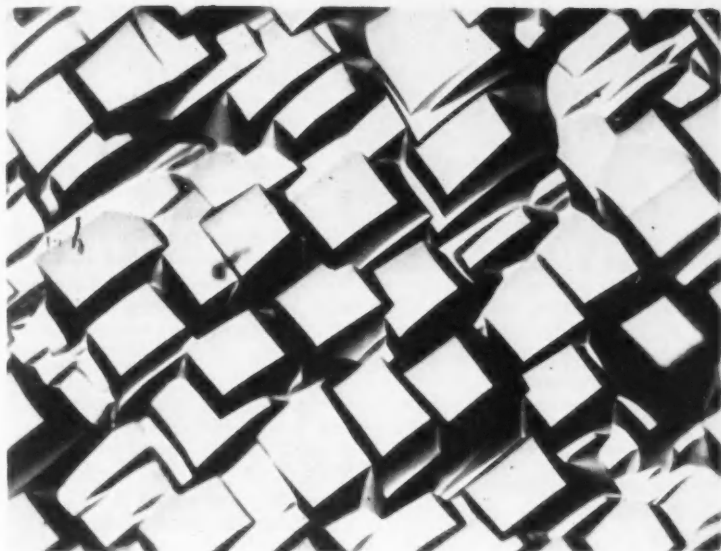
THE BIOLOGICAL EFFECTS OF ATOMIC RADIATION: Summary Reports — From a study by the National Academy of Sciences — *National Academy of Sciences—National Research Council*, 108 p., paper, free upon request direct to publisher, Washington 25, D. C. This study was conducted by committees made up of more than 100 leading scientists.

COEFFICIENCY OF VOLUME EXPANSION FOR PETROLEUM WAXES AND PURE n-PARAFFINS — P. R. Templin — *Mellon Institute*, 8 p., illus., paper, free upon request direct to publisher, 4400 Fifth Ave., Pittsburgh 13, Pa.

INFLUENCE OF GRINDING FLUIDS UPON RESIDUAL STRESSES IN HARDENED STEEL — H. R. Letner — *Mellon Institute*, 6 p., illus., paper, free upon request direct to publisher, 4400 Fifth Ave., Pittsburgh 13, Pa. Describing experiments in which air, two concentrations of rust inhibitor in water, six-miscible oils and four straight grinding oils were employed.

101 ATOMIC TERMS: And What They Mean — *Esso Research and Engineering Co.*, 20 p., illus., paper, free upon request direct to publisher, 15 W. 51st St., New York 19, N. Y. A popular type glossary defining terms used by atomic scientists, many of which are peculiar to atomic energy.

PHASE CONTRAST MICROSCOPY IN THE EXAMINATION OF STARCH GRANULES — Helen B. Wigman, William W. Leathen and Martha J. Brackmeyer — *Mellon Institute*, 6 p., illus., paper, free upon request direct to publisher, 4400 Fifth Ave., Pittsburgh 13, Pa. The phase contrast microscope provides a sharper tool for the study of these industrially important granules, which become transparent on expansion.



➤ GERMANIUM crystal etched to show the pattern of squares and rectangles that identifies the plane shown as the (100) or cube face. Hydrogen peroxide was used to etch the surface of a single crystal of this metal that is playing such an important role in modern electronics. This is a 280x photomicrograph which appeared as a figure in the Proceedings of I.R.E., November 1952 article "Preparation of Germanium Single Crystals" by Louise Roth and W. E. Taylor. Other crystal planes produce different geometrical patterns when etched. Thus the etching technique may be used to determine the orientation of single crystals.

## Germanium Crystal – Erratum

➤ THE PHOTOGRAPH above should replace the illustration in CHEMISTRY for April 1956, p. 1, illustrating the article "Electrons in Germanium." The photograph shown there is of aluminum, not germanium. No germanium of this size exists. The

picture used by mistake belongs to a series on crystal growth.

If a metal makes a contact to germanium and electrons flow from germanium to the metal, this is called an n-type rectifier. If holes are flowing from the germanium to the metal, it is called a p-type rectifier.

# Science for Youth

The Science Service Youth Program is dedicated to the discovery and development of science talent among youth. In operation since 1941, it is effective, widespread and resultful in acquainting youth with science and technology.

About 350,000 boys and girls, mostly in junior and senior secondary schools, participate in 16,000 science clubs affiliated, at no cost, with Science Clubs of America, administered by Science Service. These groups inspire and encourage science experimentation and experience through the six golden years of high school education.

## How to Affiliate

Each member belongs to a club. Each club has a sponsor who is usually a science teacher, but may be a parent, a youth leader, a professional scientist or other adult. The sponsor affiliates the club by simply writing: "I want to affiliate our science club with Science Clubs of America." He receives free materials to keep the club informed and functioning.

## Sponsor Handbook Free

The Sponsor Handbook revised and issued each year is sent free to club sponsors. It contains information on science club activities for your club, projects for your club, how to organize and conduct science fairs, facts about National Science Talent Search, an extensive list of free and low cost materials, and other valuable material.

Those who do not have a club, and do not plan to form one, may have copies of the SCA Sponsor Handbook for \$1 each.

## Science Fairs

Each April science fairs are organized through encouragement and distribution of "know-how" by Science Service. Science fairs were held in 1956 in 110 areas in the nation. More than 150,000 youths show their science and technology exhibits and projects in local or area fairs or school fairs. As top prizes at area fairs, winners are sent to the National Science Fair, conducted by Science Service since 1950, in changing cities each May. The National Science Fair will be held in Los Angeles, May 9-11, 1957 and in Flint, Michigan, May 8-10, 1958. Science fairs are conducted by local organizations that enlist participation of colleges, industries, newspapers, service clubs, school systems, museums, professional societies and other organizations.

The hope is that there will be a science fair available to every high school student. Now, well over a third of the nation is covered geographically. State academies of science and other science groups are taking leadership in the movement, cooperating with Science Service.

## Science Talent Search

The annual Science Talent Search for the Westinghouse Scholarships, conducted by Science Service since 1942, selects from all the high school seniors of continental United States, those whose scientific skill, talent and ability indicate a potential creative originality.

Each superior science student should be encouraged to enter the Science Talent Search at the beginning of his senior year.

# Science Service

## Aids to Youth



**SCIENCE NEWS LETTER**—The weekly magazine of current science. Brief, illustrated, authoritative, it keeps scientists and non-scientists alike up-to-date. \$5.50 a year. 41 weeks for \$3.13.

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**CHEMISTRY**—The pocket-size reliable magazine devoted to the simplification of technical chemistry, with vital news and the latest developments in chemistry and related fields. Dramatic, well illustrated, and readable. \$4 per year, (9 issues, September through May).

**SCIENTIFIC INSTRUMENTS YOU CAN MAKE**—How teen-age scientists have designed and built astronomical instruments, spectrosopes, Tesla coils, oscilloscopes, cloud chambers, atom counters, Van de Graaff generators, electronic computers, stroboscopes, and demonstrated ultrasonics, chromatography, photomicrography and mathematical constructions. By Helen M. Davis. Book Postpaid \$2.

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**COLOR SLIDES—Set I**—A visit to the National Science Fair—The general story of this national event told in color. Specify Set I. 30 slides with commentary. Postpaid \$6. **Set II**—The 1956 National Science Fair—A selection of exhibits from the Seventh National Science Fair held in Oklahoma City in 1956. These are the kind of exhibits that thousands of boys and girls build to show in science fairs. Specify Set II. 30 slides with commentary. Postpaid \$6.

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